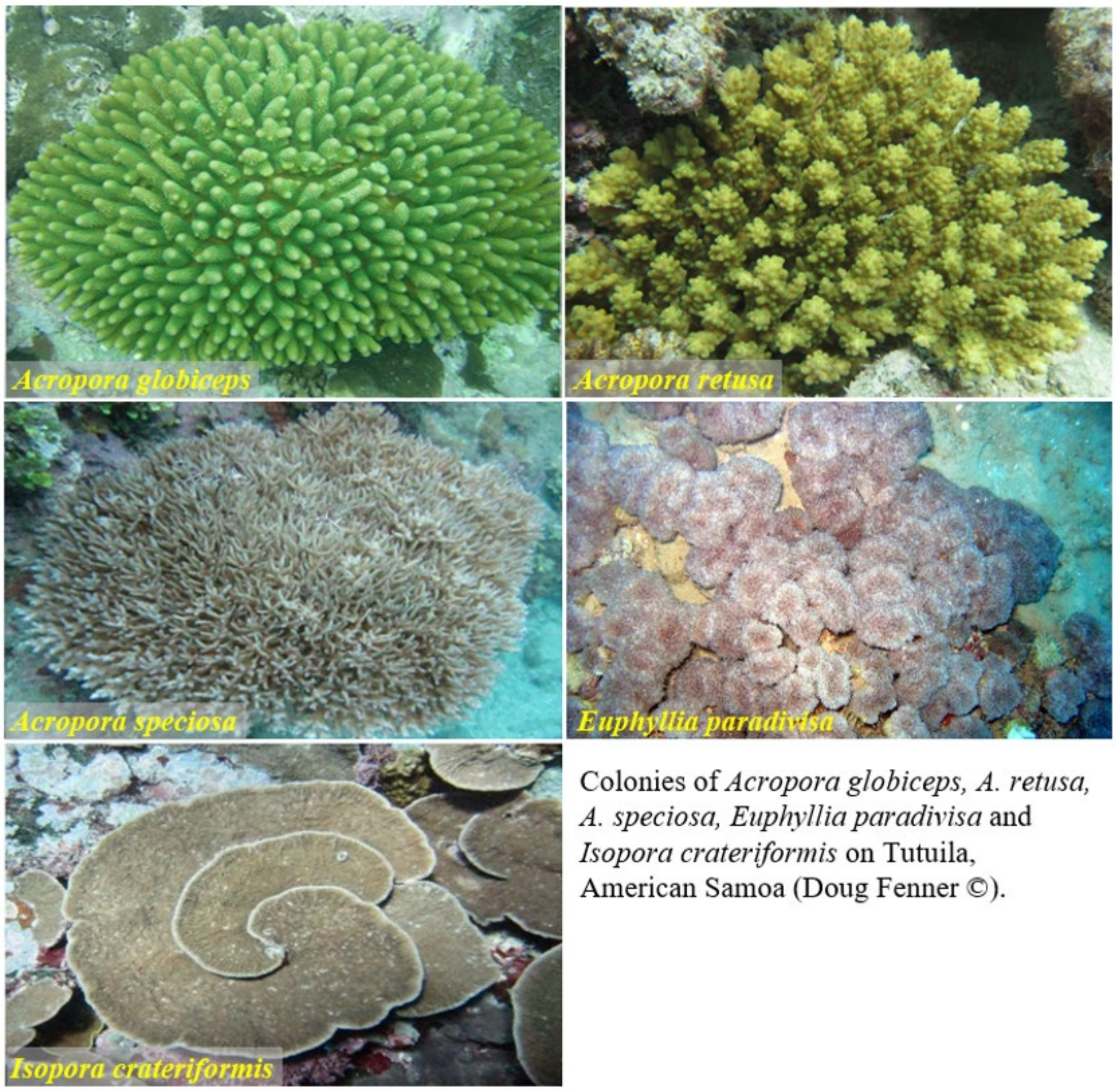
Endangered Species Act Critical Habitat Information Report: Basis and Impact Considerations of Proposed Critical Habitat Designations For Five Threatened Indo-Pacific Corals



Colonies of *Acropora globiceps, A. retusa, A. speciosa, Euphyllia paradivisa* and *Isopora crateriformis* on Tutuila, American Samoa (Doug Fenner ©).

Pacific Islands Regional Office
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Acronyms

AAFB	Andersen Air Force Base
AKA	also known as
AS	American Samoa
AToN	Aid to Navigation
CFR	Code of Federal Regulations
CNMI	Commonwealth of the Northern Mariana Islands
COTS	Crown of thorns starfish
CWA	Clean Water Act
ERA	Ecological Research Area
DAWR	Guam Department of Agriculture's Division of Aquatic Resources
DHS	Department of Homeland Security
DLNR	CNMI Department of Lands and Natural Resources
DMWR	American Samoa Department of Marine and Wildlife Resources
DOAG	Guam Department of Agriculture
DOD	US Departmet of Defense
DON	US Department of the Navy
EPA	US Environmental Protection Agency
ERA	Ecological Reserve Area
ESA	Endangered Species Act
FDM	Farallon de Medinilla
FR	Federal Register
INRMP	Integrated Natural Resources Manangement Plan
JRM	Joint Regions Marianas
MARAMP	Mariana Reef Assessment and Monitoring Program
MLA	Marine Lease Area
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NBG	Naval Base Guam
NBG/TS	Naval Base Guam/Telecommunications Site
NCCOS	National Centers for Coastal Ocean Science
NMFS	National Marine Fisheries Service (AKA NOAA Fisheries)
NPDES	National Pollutant Discharge Elimination System
NWHI	Northwestern Hawaiian Islands
PIBHMC	Pacific Islands Benthic Habitat Mapping Center
PIFSC	Pacific Islands Fisheries Science Center
PIRO	Pacific Islands Regional Office
PRIA	Pacific Remote Island Areas
RSR	Recover Status Review
SME	Subject matter expert
SWMS	shallow water mooring system
TMDL	Total Maximum Daily Load
USACE	US Army Corps of Engineers
USAF	US Air Force
USCG	US Coast Guard
USFWS	US Fish and Wildlife Serice

WPRFMC	Western Pacific Regional Fisheries Management Council

1. Introduction

Critical habitat is defined in section 3 of the Endangered Species Act (ESA or Act) (16 U.S.C. § 1532(3)) as: (1) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the ESA, on which are found those physical or biological features (a) essential to the conservation of the species and (b) that may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by a species at the time it is listed upon a determination that such areas are essential for the conservation of the species. ''Conservation'' is defined in the ESA as the use of all methods and procedures which are necessary to bring any endangered or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with science-based resource management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

In addition to the determination of physical and biological features essential for the conservation of the listed species, the ESA requires several additional analyses to inform the delineation of critical habitat. Section 4 of the ESA (16 U.S.C. § 1533) prohibits designating as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense or designated for its use that are subject to an integrated natural resources management plan (INRMP), if we determine that such a plan provides a benefit to the species. Section 4(b)(2) of the ESA requires the Secretary to take into consideration the economic impact, impact on national security, and any other relevant impacts of critical habitat designation of any particular area. Additionally, the Secretary has the discretion to exclude any area from designation if s/he determines the benefits of exclusion outweigh the benefits of designation, based on the best available scientific and commercial data.

In the final rule listing 15 Indo-Pacific and 5 Caribbean reef-building coral species as threatened under the ESA (NMFS 2014), we did not concurrently propose critical habitat but stated that we would continue to gather information and perform the required analyses of the impacts of critical habitat designation for the listed species. In 2020, we proposed critical habitat for seven listed Indo-Pacific coral species (*Acropora globiceps, Acropora jacquelineae, Acropora retusa, Acropora speciosa, Euphyllia paradivisa, Isopora crateriformis,* and *Seriatopora aculeata*; 85 FR 76262; November 27, 2020), followed by a 180-day public comment period. Based on public comments and new information, we determined that several major changes should be made to this proposed rule, as summarized in section 2.1.1 below and described in this report. Therefore , we are revising and publishing a new proposed rule, and will open a new public comment period on it.

This report provides the biological, geographic, economic, national security, and other information necessary for determining which areas are proposed as critical habitat for listed Indo-Pacific corals within U.S. Pacific Islands waters. Section 2 provides key contextual information on critical habitat, biological information on the listed corals, and an explanation for why coral critical habitat is now being proposed for only five of the seven listed coral species that were included in the 2020 proposed coral critical habitat rule. Section 3 describes the five steps of designating critical habitat for these species. Sections 4 and 5 provide the information needed to complete the analyses required by Sections 4(a)(3) and 4(b)(2) of the ESA to determine if any areas are ineligible or should be excluded from designation, respectively. Finally, Section 6 summarizes proposed coral critical habitat in the U.S. Pacific Islands.

2. Background

This section provides background on coral critical habitat, including key contextual information (U.S. waters, occupied areas, decision to re-propose, coral records), natural history (general for Indo-Pacific reef-building corals, specific for the listed species), and an explanation for why coral critical habitat is now being proposed for only five of the seven listed coral species that were included in the 2020 proposed coral critical habitat rule.

2.1. Key Contextual Information

On September 10, 2014, we listed 15 Indo-Pacific coral species as threatened under the ESA. The two most important threats to these species are both from climate change: ocean warming and ocean acidification (79 FR 53851; September 10, 2014). Section 4(a)(3)(A) of the ESA requires that, to the extent prudent and determinable, critical habitat be designated concurrently with the listing of a species as endangered or threatened. Section 4(b)(6)(C)(ii) of the ESA provides for additional time to promulgate a critical habitat designation if such designation is not determinable at the time of final listing of a species. In the final listing rule, we announced that we would continue to gather and review ongoing studies on the habitat use and requirements of the newly listed corals to attempt to identify features within those habitats that are essential to the conservation of any of the listed corals and may require special management considerations or protection.

2.1.1. **Importance of U.S. Waters**

Critical habitat can only be designated within U.S. waters. While U.S. waters represent small proportions of the overall ranges of *A. globiceps, A. retusa,* and *I. crateriformis* (NMFS 2023), these areas are important to these three species because they: (1) Consist mainly of high quality habitat; (2) provide a wide diversity of environmental conditions; (3) include isolated islands; and (4) include an archipelago where coral reef resilience to disturbance is relatively high, as described below:

1. The ranges of these three listed corals within U.S. waters are made up mostly of uninhabited or lightly inhabited islands, providing high quality habitat that promotes resilience of the listed species to the threats (NMFS 2022). These habitats are likely to become increasingly important for the conservation of the species as the threats worsen in the future.
2. The ranges of these three listed corals within U.S. waters are distributed across a wide diversity of environmental conditions, including fringing reefs on volcanic islands, barrier reefs on atolls and banks, patch reefs in lagoons and backreefs, and others (NMFS 2022). Maintaining populations across diverse environmental conditions is likely to be important for the conservation of the species as threats worsen in the future.
3. The ranges of these three listed corals within U.S. waters include some of the most isolated islands in the Indo-Pacific, including the Maug Islands, Wake Atoll, Rose Atoll, Johnston Atoll, and/or Palmyra Atoll. Populations in isolation may acclimatize or adapt in unique ways that help improve resilience of the species as threats worsen in the future.
4. In the past few decades, the reef coral communities of American Samoa have consistently recovered from several types of major disturbances, demonstrating relatively high resilience compared to other Indo-Pacific reefs (Birkeland et al. 2008, 2021). Such resilience is likely to be important for the conservation of the species as threats worsen in the future.

U.S. waters also represent very small proportions of the overall ranges of *A. speciosa* and *E. paradivisa* (NMFS 2023), being found only on Tutuila in American Samoa. However, the habitat on Tutuila is important to these species because it: (1) Consists mainly of high quality habitat; (2)

provides extensive mesophotic habitat (i.e., >30 m depth); and (3) is part of an archipelago where coral reef resilience to disturbance is relatively high, as described below:

1. Most shallow coral reefs (0 – 30 m) around Tutuila are in fair condition (Brainard et al. 2008, Waddell and Clarke 2008, NOAA CRCP 2018a), while upper mesophotic reefs around Tutuila (30 – 50 m) are in good condition (Kendall and Poti 2011, Montgomery et al. 2019, 2021). Since the depth ranges of *A. speciosa* and *E. paradivisa* on Tutuila extend to 50 m, Tutuila provides mostly high-quality habitat for these species. This habitat is likely to become increasingly important for the conservation of the species as the threats worsen in the future.
2. Tutuila has extensive upper mesophotic reef habitat, provided by a broad shelf several kilometers wide between the bottom of the fringing reef slope and a ring of outer banks (Wright et al. 2012, Montgomery et al. 2019, 2021), which together provide a large mosaic of *A. speciosa* and *E. paradivisa* habitat between 20 and 50 m depth. Protecting such extensive areas of habitat is likely to be important for the conservation of these species as threats worsen in the future.
3. In the past few decades, the reef coral communities of American Samoa have consistently recovered from several types of major disturbances, demonstrating relatively high resilience compared to other Indo-Pacific reefs (Birkeland et al. 2008, 2021). Such resilience is likely to be important for the conservation of these species as threats worsen in the future.

In conclusion, because of the importance of U.S. waters to the conservation of *A. globiceps, A. retusa, A. speciosa*, *E. paradivisa* and *I. crateriformis*, we have determined that the designation of critical habitat for these five species would be prudent.

2.1.2. Occupied Areas and Critical Habitat

The phrase "Geographical area occupied by the species" in the statutory definition of critical habitat is further defined in the ESA Section 4 implementing regulations as "An area that may generally be delineated around species' occurrences, as determined by the Secretary (i.e., range). Such areas may include those areas used throughout all or part of the species' life cycle, even if not used on a regular basis (e.g., migratory corridors, seasonal habitats, and habitats used periodically, but not solely by vagrant individuals)." (50 CFR 424.02). That is, the "Geographical area occupied by the species" (hereafter abbreviated to "occupied area") refers to the range of the species at the time of listing, based on its historical records of occurrence.

An important consideration is the spatial scale of the components of the occupied area for each listed species. Since the listed corals occur within U.S. waters across very large areas, the occupied area for each listed species could potentially consist of ecoregions (e.g., Samoa/Tonga/Tuvalu archipelagos, Veron et al. 2016), archipelagos (e.g., Samoan Islands, Mariana Islands, Hawaiian Islands), or islands. However, in the U.S. Pacific Islands, many islands within ecoregions and archipelagos are very isolated, very small, or both. Some of these islands appear to be naturally unoccupied by any listed corals, and even if they were occupied, many are so small that they may not provide the features essential to the conservation of the listed corals. That is, some islands within U.S. Pacific Islands waters may be inappropriate for coral critical habitat but would be automatically included if the occupied areas were drawn at the ecoregion or archipelago scales. Thus, the ecoregion and archipelago spatial scales are too broad for coral critical habitat. Because the U.S. Pacific Islands consist of just a few dozen islands spread across a very large area, islands are the most logical spatial scale for the occupied area of each listed species.

The 2020 proposed rule (85 FR 76262; November 27, 2020) assumed that any expert record of a listed coral species was adequate to conclude that the island was within the occupied area for that species at the time of listing (2014). However, as pointed out in the public comments and also as indicated by new information, for those islands and species with very few records, there are several reasons why such records may not provide adequate evidence that the island was within the occupied area of the listed species at the time of listing, including: (1) for listed species with high species identification uncertainty, the records may be misidentifications; (2) on islands where extensive expert surveys over many years or decades have produced only one or two records, the records may have been of vagrant individuals; and (3) in cases were extensive expert surveys were conducted both before and after listing, resulting in pre-listing records but no post-listing records, the records may be of a species that was no longer present at the time of listing. That is, the mere existence of an expert record of a listed coral from an island is not necessarily adequate to assume that the island was within the occupied area of the species at the time of listing, hence the need for a systematic methodology to assess and interpret the records to determine occupied areas.

2.1.3. **2020 Proposed Rule and Decision to Propose New Rule**

In 2020, we proposed critical habitat for the seven listed Indo-Pacific coral species that have been recorded in U.S. Pacific Islands waters (*Acropora globiceps, Acropora jacquelineae, Acropora retusa, Acropora speciosa, Euphyllia paradivisa, Isopora crateriformis,* and *Seriatopora aculeata*; 85 FR 76262; November 27, 2020). A total of 17 island areas were proposed, including 4 areas in American Samoa (Tutuila, Ofu-Olosega, Ta'u, Rose Atoll), 1 area in Guam, 7 areas in the Commonwealth of the Northern Mariana Islands (CNMI; Rota, Aguijan, Tinian, Saipan, Anatahan, Pagan, and Maug Islands), and 5 areas in the Pacific Remote Island Areas (PRIA; Howland, Palmyra, Kingman, Johnston, and Jarvis Islands). Between one and six of the above seven listed corals were thought to occur in each area, based on the best available information at that time. The initial 60-day public comment period was extended 3 times, ending on May 26, 2021, for a total of 180 days. Two online public hearings were held in January 2021. As a result, we received substantial new information during the public comment period.

We evaluated the comments and information received during the public comment period and at the public hearings that were held for the 2020 proposed rule, as well as other new information that has become available since then. Based on our consideration of the comments and information, a substantial revision of the 2020 proposed rule is needed for three main reasons:

1. The initial methodology used to compile existing records of listed coral species in U.S. waters was not exhaustive, resulting in some islands not being included in the occupied area for some listed species that should have been included.
2. The initial methodology used to determine which U.S. islands were within the occupied area for each listed coral species at the time of listing (2014) was too simple, resulting in some islands being included in the occupied area for some listed species that should not have been included.
3. The initial methodology used to determine the depth range of each listed species on each island within its occupied area used incorrect assumptions, resulting in some depth ranges being larger than they should have been.

Regarding the methodology used to compile existing records of listed coral species in U.S. waters, the 2020 proposed rule assumed that the compilation of records was exhaustive and thus reflected the best available information on the ranges of the listed species. However, as pointed out in the public comments and also as indicated by new information, the compilation of records was not exhaustive, mainly because: (1) it was thought that the federal coral reef monitoring programs were the only source of records used for most of the remote islands, but other sources also have records for some islands; (2 several previously unknown sources of photo records and expert data records have been published or shared; and (3) some historical photo records of listed species were mislabeled with the names of unlisted species. As a result, numerous existing records were not considered in the 2020 proposed rule, including some that provide the only records of any listed coral species on some islands.

Regarding the methodology used to determine which U.S. islands are within the occupied area for each listed coral species, the 2020 proposed rule assumed that any expert record of a listed coral species was adequate to conclude that the island was within the occupied area for that species at the time of listing (2014). However, as pointed out in the public comments and also as indicated by new information, for those islands with very few records for a listed coral species, there are several reasons why such records may not provide adequate evidence that the island was within the occupied area of the listed species at the time of listing, including: (1) for listed species with high species identification uncertainty, the records may be misidentifications; (2) on islands where extensive expert surveys over many years or decades have produced only one or two records, the records may have been of vagrant individuals; and (3) in cases were extensive expert surveys were conducted both before and after listing, resulting in pre-listing records but no post-listing records, the records may be of a species that was no longer present at the time of listing. That is, the mere existence of an expert record of a listed coral from an island is not necessarily adequate to assume that the island was within the occupied area of the species at the time of listing.

Regarding the methodology used to determine the depth ranges, the 2020 proposed rule assumed that the depth range of a listed coral species shown by the records from an extensively surveyed island was representative of that species' depth range on other islands or archipelagos. For example, since the records of *A. globiceps* from Tutuila showed a depth range of 0 – 20 m on that island, the rule assumed that the species' depth range was 0 – 20 m on other islands within (e.g., Rose Atoll) and outside (e.g., Guam) the Samoan Archipelago. However, as pointed out in the public comments and also as indicated by new information, the depth range of a listed coral species can vary from island to island, especially between archipelagos. For example, extensive surveys between 10 and 20 m on both Tutuila and Guam indicate that *A. globiceps* is commonly found to 20 m on Tutuila but only to 12 m in Guam.

To address these three problems with the 2020 proposed rule, a systematic methodology was developed and implemented for compilation, assessment, and interpretation of the records of each listed coral species in order to determine its occupied area within U.S. waters at the time of listing in 2014 (i.e., which islands) as well as the depth range of each species on each of those islands. This methodology is entirely new and resulted in changes to the occupied area (i.e., which islands are included or not, as well as depth ranges) of critical habitat for most listed coral species. Thus, it is necessary to publish a new proposed rule to provide the public an opportunity to comment on the methodology and its results.

2.1.4. New Methodology for Using Records to Determine Occupied Areas

The determinations of the occupied areas that make up critical habitat are based on the records of each listed coral species within U.S. waters. However, using the records for critical habitat requires overcoming three major challenges: (1) Finding all the records in the first place (compilation); (2) accounting for the high variability in the quality, quantity, age, species identification uncertainty, survey effort, and other factors associated with the records (assessment); and (3) interpreting the records to determine which islands are within the occupied area for each listed species and thus should be included in critical habitat (application). In order to address these challenges and ensure that coral critical habitat is based on the best available information, we compiled all the available records for each listed coral species around each island within U.S. Pacific Islands jurisdictions and developed a consistent and transparent methodology for assessing and applying the records. The results are provided in Appendix A of this report (the "Records Document") and were applied throughout this report and the new proposed rule. The compilation, assessment, and application of the records are summarized from the Records Document below.

2.1.4.1. Compilation

The available records for each listed coral species around each island within U.S. Pacific Islands waters were compiled via the following steps: (1) Reviewed all relevant NOAA Fisheries files, such as those used for the final coral listing rule and proposed critical habitat; (2) gathered records from government agencies that have conducted coral reef monitoring within these areas; (3) gathered records from other sources such as research projects, site surveys, area inventories, etc.; (4) conducted an exhaustive online search; and (5) consulted with experts from the Territorial Governments (American Samoa, Guam, CNMI) and the Marine National Monuments (Rose Atoll, Pacific Remote Islands, Marianas Trench) to ensure that no records were overlooked. The search produced records of seven listed coral species (*A. globiceps, A. jacquelineae, A. retusa, A. speciosa, E. paradivisa, I. crateriformis,* and *S. aculeata*) from U.S. Pacific Islands waters (Appendix A).

The records were divided into 45 records groups by island and species: In this document, atolls (e.g., Rose Atoll) and stand-alone reefs (e.g., Kingman Reef), shoals (e.g., French Frigate Shoals), and pinnacles (e.g., Gardner Pinnacles) are all referred to as “islands”. The 45 records groups from 24 islands included 4 islands in American Samoa (Tutuila and Offshore Banks, Ofu-Olosega, Ta'u, Rose Atoll), 1 island in Guam (Guam), 9 islands in CNMI (Rota, Aguijan, Tinian, Saipan, Farallon de Medinilla, Alamagan, Pagan, Maug Islands, Uracas), 7 islands in PRIA (Howland, Baker, Palmyra Atoll, Kingman Reef, Johnston Atoll, Wake Atoll, Jarvis), and 3 islands in the Northwestern Hawaiian Islands (NWHI; French Frigate Shoals, Maro Reef, Gardner Pinnacles) in Hawaii, as shown in Table 2 of Appendix A. No records for any listed species were available from any of the Main Hawaiian Islands. The 45 records groups were assessed as described in the following section (Appendix A).

2.1.4.2. Assessment

Each of the 45 records groups (i.e., all records of a listed species from an island) was assessed in terms of the following factors: (1) quality of records; (2) quantity of records; (3) age of records; (4) species identification uncertainty; (5) survey effort; and (6) other factors. Each factor is summarized below and explained in more detail in the Records Document (Appendix A).

<u>Quality of Records</u>. The quality of records was addressed by categorizing records as “photo records,” “expert data records,” or “other records.” Because of species identification uncertainty, photo records are ideal, if the location and date of the photo are known, and the photo clearly shows colony and branch morphology are clear. However, many records of coral species are in the form of data sheets or species lists and lack photos. Any such record collected by a recognized Indo-Pacific reef-building coral species expert is considered an expert data record. The experts who did the large majority of the species identifications for the expert data records are listed in Appendix A. Records that do not meet the criteria for photo records or expert data records are considered other records (e.g., personal communications). Such records have higher uncertainty than photo records or expert data records, but still may provide valuable information.

We confirmed all records via direct communication with the experts who took the records, or with experts who were able to vouch for the records. Our determinations of whether the island was within the occupied area for a listed species at the time of listing relied almost entirely upon photo records and expert data records. However, other records provided valuable information for some islands or parts thereof (Appendix A).

<u>Quantity of Records</u>. The quantity of records is an important consideration, since the more photo records and expert data records we have for a species from an island, the greater the likelihood that the island was within the occupied area for a listed species at the time of listing. Islands with a

single photo record or expert data record of a listed species may or may not have been within the occupied area of that species at the time of listing (2014), depending on other factors (Appendix A).

Age of Records. Older records are not necessarily lower quality; thus age of records is not addressed in Quality of Records above. However, the older a record is, the less relevance it has to our determination of whether the island was within the occupied area for a listed species at the time of listing (Appendix A).

Species Identification Uncertainty. Species identification uncertainty is substantial for most of the 15 listed Indo-Pacific reef coral species, even for experts. For listed coral species that are consistently distinct from similar species and frequently observed, species identification uncertainty has decreased since listing, as survey effort and expertise have increased. This is the case with *A. globiceps* and *I. crateriformis*. In addition, *E. paradivisa* and *S. aculeata* are consistently distinct from similar species, although they are very infrequently observed within U.S. waters. For these four listed species, identification uncertainty is relatively low now for coral species experts based in the U.S. Pacific Islands (Appendix A).

In contrast, for listed species that are very similar to other species, the increase in survey effort since listing in 2014 has emphasized the difficulty in distinguishing them. This is the case with *A. retusa*, especially in the Marianas and PRIA. The combination of high colony morphological variability and low numbers of records in Guam-CNMI and PRIA is such that we have low confidence in these records, even though they are expert data records. Even more challenging are those listed species that are very similar to other species but are very infrequently observed, such as *A. jacquelineae* and *A. speciosa*. For these three listed species, identification uncertainty is relatively high now, even for coral species experts who focus on the U.S. Pacific Islands (Appendix A).

Survey Effort. Survey effort refers to the amount of expert coral species surveys that have been conducted on an island. Historical survey effort has been highly variable from island to island, potentially influencing the interpretation of the records. However, all islands in this document except Farallon de Medinilla (FDM) in CNMI have been included in the Pacific Islands Fisheries Science Center's (PIFSC) species-level standardized coral reef monitoring surveys at least one time since listing in 2014, and some islands have also been included in standardized surveys by other agencies. PIFSC's surveys are quite extensive around each island, including many transects and covering wide depth ranges (Appendix A).

The Department of the Navy (DON) restricts access to FDM, hence PIFSC does not survey there. However, the Navy periodically conducts species-level coral surveys at FDM, thus numerous surveys have been conducted on FDM both around and since the time of listing. All islands have been subject to extensive species-level surveys (i.e., the PIFSC and DON surveys) around or since the time of listing, including within the depth ranges and habitat types of all listed coral species (Appendix A).

Other Factors. In addition, other factors should be taken into consideration in assessment of the records, such as taxonomic issues, morphological variability across archipelagos, and habitat preferences. Taxonomic issues include confusion of *A. globiceps* with *A. humilis,* and the name change from *Acropora crateriformis* to *Isopora crateriformis*, both of which affect treatment of historical records (Appendix A).

A particular species identification uncertainty problem is the apparent variability in colony morphology of *A. retusa* and related species between the American Samoa, Guam-CNMI, and PRIA archipelagos. As explained in the *A. retusa* section of Appendix A, the combination of high colony morphological variability and low numbers of records in Guam-CNMI and PRIA is such that we have low confidence in these records, even though they are expert data records. However, in American Samoa, there is apparently lower colony morphological variability and higher numbers of records for *A. retusa*, thus we have high confidence in these records (Appendix A).

Finally, some types of coral reef habitats are surveyed more than others, mainly because of accessibility and safety. Of the surveys that produced the records in this document, the majority took place on forereefs (AKA reef slopes) between about 5 and 20 m of depth, and some surveys included reef slopes of 20 – 30 m depth. Fewer surveys were done in backreef habitats, such as pools, lagoons, and reef flats, raising the possibility that the records may not be representative of species' distributions across habitats. However, for some of the more frequently surveyed islands, some habitat-specific information is available, as noted in the species-island sections (Appendix A).

2.1.4.3. Application

After we compiled and assessed each of the 45 records groups (i.e., all records of a listed species from an island), we rated the level of evidence provided by each group that the island was within the occupied area for the listed species at the time of listing in 2014, using a systematic rating system. Finally, we interpreted the rating results of each records group to determine whether the island was within the occupied area for the listed species at the time of listing, and thus should be included in critical habitat (Appendix A).

<u>Rating System</u>. Based on all the assessment factors except species identification uncertainty, each records group was characterized as falling into one of the following five qualitative categories. The categories provide a range of evidence that the island was within the occupied area for the listed species at the time of listing in 2014, from the least to the most:

1. Up to a few pre-listing photo or expert data records are available, but no post-listing records are available.
2. Up to a few post-listing photo or expert data records are available, but post-listing standardized monitoring surveys have not detected colonies.
3. More than a few post-listing photo or expert data records are available, but post-listing standardized monitoring surveys have not detected colonies.
4. More than a few post-listing photo or expert data records are available, and post-listing standardized monitoring surveys have detected colonies.
5. At least dozens of post-listing photo and expert data records are available, and post-listing standardized monitoring surveys have detected colonies at multiple sites over multiple years.

In addition, the evidence provided by the records is influenced by species identification uncertainty, as described in detail in Appendix A. Species identification uncertainty is factored into the evidence ratings as follows: For each of the five qualitative categories, evidence for species with high identification uncertainty is given less weight than species with low identification uncertainty, which is reflected in the evidence rating system described below.

Taking all the assessment factors into consideration, we rated each records group in terms of the evidence that the island was within an occupied area for the listed species at the time of listing as between 1 (least likely) and 10 (most likely; Table 1), based on the five categories of evidence x the two types of species identification uncertainty. For example, for evidence category #1, species with high identification uncertainty are rated as 1, and species with low identification uncertainty are rated as 2. When the records for species with high vs. low species identification uncertainty are in the same evidence category, species with high identification uncertainty are always rated lower (Table 1).

Table 1. Rating system for evidence provided by each records group that the island was within the occupied area for the listed species at the time of listing in 2014 (Appendix A).

Rating	Species ID Uncertainty	Evidence Category for Records Group
1	High	Up to a few pre-listing photo or expert data records are available, but no post-listing records are available.
2	Low	
3	High	Up to a few post-listing photo or expert data records are available, but post-listing standardized monitoring surveys have not detected colonies.
4	Low	
5	High	More than a few post-listing photo or expert data records are available, but post-listing standardized monitoring surveys have not detected colonies.
6	Low	
7	High	More than a few post-listing photo or expert data records are available, and post-listing standardized monitoring surveys have detected colonies.
8	Low	
9	High	At least dozens of post-listing photo and expert data records are available, and post-listing standardized monitoring surveys have detected colonies at multiple sites over multiple years.
10	Low	

Each of the 45 records groups were rated in terms of the evidence that the island was within the occupied area for the species at the time of listing (2014), based on the 10 evidence categories described in Table 1 above:

1. Ten records groups were rated as 1: *A. jacquelineae* from Tutuila; *A. retusa* from Ta'u, Guam, Rota, Tinian, Howland, Kingman Reef, and Johnston Atoll; and *A. speciosa* from Guam and Kingman Reef.
2. Seven records groups were rated as 2: *A. globiceps* from Howland, Baker, Kingman Reef, Maro Reef, and Gardner Pinnacles; and *S. aculeata* from Guam and Saipan.
3. One records group was rated as 3: *A. retusa* from Jarvis.
4. Two records groups were rated as 4: *A. globiceps* from Alamagan and Uracas.
5. Two records groups were rated as 5: *A. retusa* from Wake Atoll; and *A. speciosa* from Tutuila.
6. Seven records groups were rated as 6: *A. globiceps* from Ta'u, Rose, FDM, Palmyra, Johnston, and FFS; and *E. paradivisa* from Tutuila.
7. One records group was rated as 7: *A. retusa* from Ofu-Olosega.
8. Six records groups were rated as 8: *A. globiceps* from Ofu-Olosega, Aguijan, Pagan, Maug Islands, and Wake Atoll; and *I. crateriformis* from Ta'u.
9. Two records groups were rated as 9: *A. retusa* from Tutuila and Rose Atoll.
10. Seven records groups were rated as 10: *A. globiceps* from Tutuila, Guam, Rota, Tinian, and Saipan; and *I. crateriformis* from Tutuila and Ofu-Olosega (Appendix A).

<u>Interpretation of Ratings</u>. We interpreted the ratings of the records groups in terms of the likelihood that the island was within the occupied area for the listed species at the time of listing in 2014. As explained in more detail in Section 2.1.2 above, for the purposes of critical habitat, an occupied area is one that was used at the time of listing by the species for all or part of its life cycle, including migratory corridors, seasonal habitats, and habitats used periodically, but not areas used solely by vagrant individuals (i.e., waifs). When records groups include multiple records, typically such records provide strong evidence that the island was within the occupied area of the listed species at the time of listing.

Ratings of 1 – 3 provide inadequate evidence that the island was within the occupied area for the listed species at the time of listing, as explained in the following ratings descriptions. Eighteen of the records groups were rated as 1 – 3, and all but one of these had only one or two records each. The remaining records group (*S. aculeata* from Guam) had a few records, two of which were collected approximately 50 years before listing. Of these 18 records groups, ten were rated as 1, seven as 2, and one as 3 (Appendix A, Table 2). The rationales for why these 18 records groups provide inadequate evidence for the species being within the occupied area at the time of listing are provided below.

One *A. jacquelineae* records group was rated as 1 (Tutuila), a species with high species identification uncertainty even for trained experts. This record consists of photos of a single colony of *A. jacquelineae* on Tutuila taken in 2008. Since then, hundreds of expert surveys have been conducted on Tutuila within the habitat and depth range of the species, including at the location of the original record, but no other records have been documented. As noted in Section 1.2 above, the statutory definition of an occupied area does not include habitats used solely by vagrant individuals (i.e., waifs). Waifs are a single individual or small group of individuals found outside of its normal range, presumably advected by unusual currents or weather conditions (Johnson et al. 2000), which are common among reef corals (Turak and DeVantier 2019). Because no other colonies of *A. jacquelineae* have been observed before or since 2008 on Tutuila despite very extensive expert surveys, there is considerable likelihood that the single observed colony of *A. jacquelineae* on Tutuila was a waif colony. Since occupied areas do not include habitats used solely by vagrant individuals (i.e., waifs), this record provides inadequate evidence that Tutuila was within the occupied area of *A. jacquelineae* at the time of listing in 2014 (Appendix A).

Seven *A. retusa* records groups were rated as 1 (Ta'u, Guam, Rota, Tinian, Howland, Kingman Reef, Johnston), a species with high species identification uncertainty even for trained experts. All seven records groups consist of one or two records collected at least several years before listing (2004 – 2010). Five of the records groups each consist of one or two photo records that all appear to be of closely-related but undescribed species. The other two records groups (Ta'u, Rota) each consist of a single expert data record but because of species identification uncertainty and lack of photos, identifications could not be confirmed. Because these records groups each consist of only one or two ambiguous records collected at least several years before listing, and expert surveys of all seven islands since listing have not recorded any *A. retusa* colonies, these records groups provide inadequate evidence that any of the seven islands were within the occupied area of *A. retusa* at the time of listing in 2014 (Appendix A).

Two *A. speciosa* records groups were rated as 1 (Guam, Kingman Reef), a species with high species identification uncertainty even for trained experts. The Guam records group consists of several photos of a single colony in Apra Harbor of Guam taken in 2010. Definitive species identification requires examination of a skeletal sample, but no sample was taken. Many subsequent expert dives and surveys were conducted in the area in the following years, but neither the original colony nor any other colonies resembling *A. speciosa* were recorded. The Kingman Reef records group consists of a single expert data record collected between 2004 and 2006 with no photos or skeletal sample. Because these records groups each consist of only a single ambiguous colony recorded at least several years before listing, and expert surveys of both islands since listing have not recorded any *A. speciosa* colonies, these records groups provide inadequate evidence that either island was within the occupied area of *A. speciosa* at the time of listing in 2014 (Appendix A).

Five *A. globiceps* records were groups rated as 2 (Howland, Baker, Kingman Reef, Maro Reef, Gardner Pinnacles), a species with low species identification uncertainty for trained experts. All five records groups consist of one or two photo records collected at least several years before listing (2000 – 2006). The three records groups from PRIA (Howland, Baker, Kingman Reef) each consist of one or two photo records taken between 2004 and 2006 and identified by an expert at that time but that are clearly not *A. globiceps*, and thus provide no evidence that these three islands were within the occupied area of *A. globiceps* at the time of listing in 2014. The two records groups from NWHI (Maro Reef, Gardner Pinnacles) are a photo of a single colony from 2004 (Maro Reef) and photos of a group of colonies in close proximity from 2000 (Gardner Pinnacles). Because these records groups each consist of only a single colony or group of colonies (i.e., likely clones) collected many years before listing, multiple expert surveys conducted at Maro Reef and Gardner Pinnacles through 2008 did not record any *A. globiceps* colonies, and an expert survey of both islands since listing did not record any *A. globiceps* colonies, these records groups provide inadequate evidence that either island was within the occupied area of *A. globiceps* at the time of listing in 2014 (Appendix A).

Two *S. aculeata* records groups were rated as 2 (Guam, Saipan), a species with low species identification uncertainty for trained experts. The Guam records group consists of three photo records (two from the 1970s and one from 2008-2010), while the Saipan records group consists of an expert data record of a group of colonies in close proximity (i.e., likely clones) from 2011. Since 2010 and 2011, hundreds of expert surveys have been conducted on Guam and Saipan within the habitat and depth range of *S. aculeata*, but no additional records have been documented. Since the most recent of these records were collected in 2010 and 2011, there have been sharp declines in coral cover throughout Guam and Saipan, especially of branching corals such as *S. aculeata*, due to a multitude of disturbances. Because these records groups each consist of only a few records collected before listing, hundreds of expert surveys have been conducted on Guam and Saipan since listing but did not record any additional *S. aculeata* colonies, and sharp declines in coral cover of branching corals such as *S. aculeata* on Guam and Saipan started before listing, these records groups provide inadequate evidence that either island was within the occupied area of *S. aculeata* at the time of listing in 2014 (Appendix A).

One *A. retusa* records group was rated as 3 (Jarvis), a species with high species identification uncertainty even for trained experts. This records group consists of a single photo taken in 2018 although the photo does not clearly show branch and colony morphology. Like the other *A. retusa* photo records from PRIA, the colony could only be identified as possible *A. retusa* colonies because of a combination of species identification uncertainty and taxonomic ambiguity. Because *A. retusa* has high species identification uncertainty especially in PRIA, the records group consists of only one poor quality and ambiguous photo record, and post-listing standardized monitoring surveys in 2015 and 2018 at Jarvis did not detect any *A. retusa* colonies, this records group does not provide adequate evidence that Jarvis within the occupied area of *A. retusa* at the time of listing in 2014 (Appendix A).

Ratings of 4 – 10 provide adequate evidence that the island was within the occupied area for the listed species at the time of listing, as explained in the following ratings descriptions. Twenty-seven of the records groups were rated as 4 – 10, each of which had between one and hundreds of records. Of these 27 records groups, two records groups were rated as 4, two as 5, seven as 6, one as 7, six as 8, two as 9, and seven as 10 (Appendix A, Table 2). The rationales for why these 27 records groups provide adequate evidence for the species being within the occupied area at the time of listing are provided below.

Two *A. globiceps* records groups were rated as 4 (Alamagan, Uracas), a species with low species identification uncertainty for trained experts. These records group consists of one (Alamagan) and two (Uracas) photo records, all taken in 2017. No expert surveys have been conducted on either island since then, except PIFSC's standardized monitoring survey in 2022, details for which are not available at the time of this writing (June 2022). Because *A. globiceps* has low species identification uncertainty, and these records consist of photo records taken in 2017, these records groups provide adequate evidence that the two islands were within the occupied area of *A. globiceps* at the time of listing in 2014 (Appendix A).

Two records groups were rated as 5, *A. retusa* from Wake Atoll, and *A. speciosa* from Tutuila, species with high species identification uncertainty even for trained experts. The *A. retusa*/Wake records group consists of many photo and expert data records since listing in 2014 although standardized monitoring surveys have not detected the species on Wake. The *A. speciosa*/Tutuila records group consists of several photo and expert data records before and after listing in 2014, including two from 2016 that were confirmed with skeletal samples, and one record from a standardized monitoring survey but it was not confirmed with a skeletal sample. Although both species have high species identification uncertainty even for trained experts, the *A. retusa*/Wake records group consists of many photo and expert data records since listing, and the *A. speciosa*/Tutuila records group includes multiple post-listing records that were confirmed with skeletal samples. Thus the records groups provide adequate evidence that Wake Atoll was within the occupied area of *A. retusa*, and that Tutuila was within the occupied area of *A. speciosa*, at the time of listing in 2014 (Appendix A).

Seven records groups were rated as 6, six for *A. globiceps* (Ta'u, Rose Atoll, FDM, Palmyra Atoll, Johnston Atoll, FFS), and one for *E. paradivisa* from Tutuila, species with low species identification uncertainty for trained experts. Each of the seven records groups include several records collected before and after listing in 2014. Because both species have low species identification uncertainty, multiple records are available for all seven islands, and records were collected after listing, these records groups provide adequate evidence that the six islands were within the occupied area of *A. globiceps*, and that Tutuila was within the occupied area of *E. paradivisa*, at the time of listing in 2014 (Appendix A).

One *A. retusa* records group was rated as 7 (Ofu-Olosega), a species with high species identification uncertainty even for trained experts. This records group consists of several records collected before and after listing in 2014. Although *A. retusa* generally has high species identification uncertainty, colonies of the species have a typical and distinct appearance in American Samoa. Because multiple records are available, some of which were collected after listing, this records group provides adequate evidence that Ofu-Olosega was within the occupied area of *A. retusa* at the time of listing in 2014 (Appendix A).

Six records groups were rated as 8, five for *A. globiceps* (Ofu-Olosega, Aguihan, Pagan, Maug Islands, Wake Atoll), and one for *I. crateriformis* from Ta'u, species with low species identification uncertainty for trained experts. Each of the six records groups consist of many records collected after listing in 2014. Because both species have low species identification uncertainty, and many records are available for all six islands since listing, these records groups provide adequate evidence that the five islands were within the occupied area of *A. globiceps*, and that Ta'u was within the occupied area of *I. crateriformis*, at the time of listing in 2014 (Appendix A).

Two *A. retusa* records groups were rated as 9 (Tutuila, Rose Atoll), a species with high species identification uncertainty even for trained experts. These records groups each consist of dozens of records collected after listing in 2014. Although *A. retusa* generally has high species identification uncertainty, colonies of the species have a typical and distinct appearance in American Samoa. Because dozens of records are available from after listing for both islands, these records groups provides adequate evidence that Tutuila and Rose Atoll were within the occupied area of *A. retusa* at the time of listing in 2014 (Appendix A).

Seven records groups were rated as 10, five for *A. globiceps* (Tutuila, Guam, Rota, Tinian, Saipan), and two for *I. crateriformis* (Tutuila, Ofu-Olosega), species with low species identification uncertainty for trained experts. Each of the seven records groups consist of dozens to hundreds of records collected after listing in 2014. Because both species have low species identification uncertainty, and many records are available for all seven islands since listing, these records groups provide adequate evidence that the five islands were within the occupied area of *A. globiceps*, and that Tutuila and Ofu-Olosega were within the occupied area of *I. crateriformis*, at the time of listing in 2014 (Appendix A).

2.1.4.4. *Occupied Areas and Depth Ranges for New Proposed Rule*

In summary, 18 records groups each provide inadequate evidence that the island was within the occupied area of the listed species at the time of listing, while 27 records groups each provide adequate evidence that the island was within the occupied area of the listed species at the time of listing. These 27 records groups were from 18 islands for *A. globiceps*, 4 islands for *A. retusa*, 1 island each for *A. speciosa* and *E. paradivisa*, and 3 islands for *I. crateriformis* (Appendix A).

In addition, the 27 records groups were used to determine the depth range of each listed species around each island, another important component of critical habitat. For *A. globiceps*, the depth ranges were 0 – 20 m (3 islands), 0 – 12 m (10 islands), and 0 – 10 m (5 islands). For the other 4 species, the depth ranges were 0 – 20 m for *A. retusa* (4 islands) and *I. crateriformis* (3 islands), and 20 – 50 m for *A. speciosa* and *E. paradivisa* (1 island each, Appendix A).

2.2. Natural History

This section summarizes life history and biological characteristics of the threatened Indo-Pacific corals to provide context for the determination of physical or biological features that are essential for the conservation of these species. Since reef-building corals share many characteristics, and also because of the lack of species-specific information for listed species, a general description of the approximately 800 species of Indo-Pacific reef-building corals is provided in section 2.2.1 below. Summaries of natural history and biological information for the five species included in the new proposed rule (*A. globiceps, A. retusa, A. speciosa, E. paradivisa, I. crateriformis*) are provided in section 2.2.2.

2.2.1. **Indo-Pacific Reef-building Corals**

Reef-building corals such as the 15 listed Indo-Pacific coral species are defined by symbioses with unicellular photosynthetic algae living within their tissues (zooxanthellae), hence they are sometimes referred to as “zooxanthellate” or “hermatypic” corals. The symbiosis provides them the capacity to grow large skeletons and thrive in nutrient-poor tropical and subtropical seas. Reef-building corals collectively produce shallow coral reefs over time, although they also occur in non-reef and mesophotic habitats. Over 90% of reef-building coral species occur in the Indian and Pacific Oceans (i.e., the Indo-Pacific Realm, Veron 2000).

Reef-building corals are marine invertebrates in the phylum Cnidaria that occur as polyps, usually forming colonies of many clonal polyps on a calcium carbonate skeleton. The Cnidaria include true stony corals (class Anthozoa, order Scleractinia, including both reef-building, zooxanthellate and non-reef-building, azooxanthellate species), the blue coral (class Anthozoa, order Helioporacea), and fire corals (class Hydrozoa, order Milleporina). Most reef-building corals form complex colonies made up of a tissue layer of polyps (a column with mouth and tentacles on the upper side) growing on top of a calcium carbonate skeleton, which the polyps produce through the process of calcification (Brainard et al. 2011, NMFS 2014).

Indo-Pacific reef-building coral communities are in decline due to increasingly frequent, severe, and widespread anthropogenic disturbance over at least the last several decades. Although many studies show the capacity of these communities to recover from many types of disturbance, recovery times have steadily declined with the increasing frequency of disturbance. All types of anthropogenic disturbance are projected to increase in frequency, severity, and scale over the remainder of the 21st century. The available information clearly indicates that mean coral cover has declined across many Indo-Pacific coral reefs since the 1970s, and likely many decades before then in some locations. High spatial and temporal variability influenced by a large number of natural and anthropogenic factors can mask the overall trend in coral cover, but long-term monitoring programs and meta-analyses demonstrate downward temporal trends in most of the Indo-Pacific. Because disturbance is projected to increase over the remainder of the 21st century, with the subsequent further decline in recovery times, mean coral cover on Indo-Pacific coral reefs is also projected to further decrease (Brainard et al. 2011, NMFS 2014, Smith 2019, NMFS 2020b).

The decision about whether or not to list a species as threatened or endangered under the ESA requires determination of the status of the species currently and over the foreseeable future (ESA section 4). However, Indo-Pacific reef-building corals have many biological and habitat features that complicate the determination of the status of any given species, including but not necessarily limited to: most are modular, colonial, and sessile; the definition of the individual is ambiguous; the taxonomy of many species is uncertain; field identification of many species is difficult; colonies or polyps are a collection of coral-algae-microbe symbiotic relationships; skeletal plasticity is high within many species; they utilize a combination of sexual and asexual reproduction; hybridization may be common in many species; high habitat heterogeneity fosters acclimatization and adaptation to wide ranges of environmental conditions; and large ranges encompass habitats that provide refuges from disturbances (Brainard et al. 2011, Smith 2019).

These factors were considered in the final listings of the 15 listed corals (NMFS 2014), the Not Warranted determinations for the 60 other petitioned species (NMFS 2014), the Not Warranted determination for *Pocillopora meandrina* (NMFS 2020b) in response to a petition to list that species, and the draft Recovery Status Review (NMFS 2022) for the Draft Recovery Plan currently being developed by NMFS.

This document follows Charlie Veron's geographic definition of the Indo-Pacific Realm, and list of Indo-Pacific reef-building coral species used in his Corals of the World (COTW) website (Veron et al. 2016). The website builds upon Veron's books and papers, and represents the most complete database of reef-building coral biogeography currently available. The Indo-Pacific realm includes all coral reefs in the Indian and Pacific Oceans (Fig. 1), which has been divided by Veron into 133 ecoregions based on reef-building coral and habitat characteristics (Veron et al. 2015). COTW currently recognizes 831 species of reef-building corals in the world, including 758 Indo-Pacific species (http://www.coralsoftheworld.org accessed January 2021), with the highest numbers in eastern Indonesia (>600 spp.) and the lowest in peripheral areas such as the eastern Pacific (<50 spp.; Veron et al. 2015, 2016).

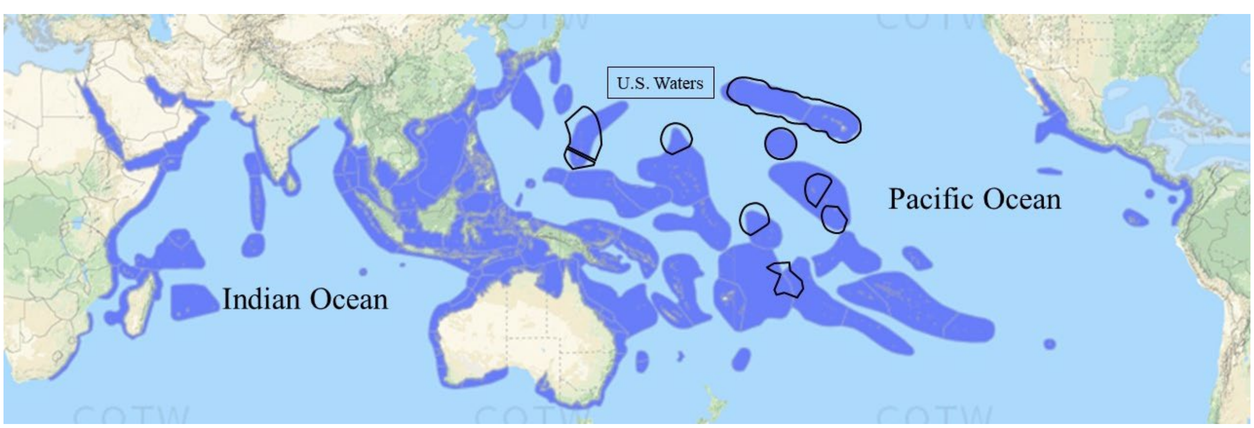

Figure 1. Ranges of Indo-Pacific Reef-building Corals. Map showing in purple the collective ranges of 758 Indo-Pacific reef-building corals, based on Veron's 133 Indo-Pacific ecoregions (Veron et al. 2016, map created January 2021). U.S. waters are shown for reference.

The hundreds of Indo-Pacific reef-building coral species occur in a wide diversity of growth forms, several of which are represented by the 15 listed corals. The seven *Acropora* species, *Anacropora spinosa, Porites napopora,* and *Seriatopora aculeata* all form branching colonies, but with a wide variety of branch sizes and shapes. *Isopora crateriformis* forms encrusting plates, *Montipora australiensis* forms thick submassive plates and irregular columns, and *Pavona diffluens* forms submassive colonies. While these 14 listed species each have distinctive colony forms, they all have relatively small corallites (<1 mm to a few mm in diameter) spread across branches or colony surfaces, with correspondingly small tentacles that are usually not extended during the daytime. In contrast, colonies of *E. paradivisa* are made up of a mass of large corallites (20-30 mm diameter) that each form its own branch, but colony shape is often obscured by large, extended tentacles (Veron et al. 2016).

2.2.2. Natural History of the Five Listed Corals in New Proposed Rule

Summaries of natural history and biological information for the five species included in the new proposed rule (*A. globiceps, A. retusa, A. speciosa, E. paradivisa, I. crateriformis*) are provided below.

2.2.2.1. *Acropora globiceps*

Morphology, species identification, life history, habitat, depth, distribution, and occurrence in U.S. waters for *A. globiceps* are summarized here, based on the more detailed species account in the draft Recovery Status Review (RSR; NMFS 2022) and the Records Document (Appendix A).

<u>Morphology</u>. Colonies of *A. globiceps* are typically about 25 cm in diameter or less but can reach approximately 1 m in diameter. Colonies are round, with digitate (finger-like) branches growing upward. Colony color is typically cream to brown, and sometimes fluorescent green in some locations (Fenner and Burdick 2016, Fenner 2020). Like other members of the “humilis group” of *Acropora* species, the thick, sturdy colonies of *A. globiceps* are well-adapted for the shallow, high-energy habitats where they are most often found (Wallace 1999, Wallace et al. 2012).

<u>Species Identification</u>. Species identification uncertainty for *A. globiceps* and the other listed corals has evolved since the listings in 2014, because of much greater effort by reef coral experts to identify the listed species during coral reef monitoring surveys and other work. PIRO’s Coral Species Identification Training Program’s annual workshops have facilitated this learning process (NMFS 2018, 2019). As described in NMFS (2022), *A. globiceps* has often been mistaken for *A. humilis*. However, according to Wallace’s worldwide revision of the genus *Acropora* (Wallace 1999), *A. globiceps* and *A. humilis* are both distinctive species, which was supported by Wallace et al.’s (2012) additional revision of the genus *Acropora*. Both species are now recognized by the COTW books (Veron 2000) and website (Veron et al. 2016), as well as the World Register of Marine Species (WoRMS, Hoeksma and Cairns 2021).

Species identification uncertainty for the listed corals has evolved since the listings in 2014, because of much greater effort by reef coral experts to identify the listed species during coral reef monitoring surveys and other work. The NMFS Pacific Islands Regional Office’s (PIRO’s) Coral Species Identification Training Program’s annual workshops have facilitated this learning process (NMFS 2018, 2019). Since *A. globiceps* is found across most of the U.S. Pacific Islands, and its colonies usually have a typical and distinct appearance (Fenner and Burdick 2016, Fenner 2020), current species identification uncertainty is considered low for *A. globiceps* (Appendix A).

<u>Life History</u>. Like other *Acropora* species, *A. globiceps* reproduces by broadcast spawning, whereby colonies release large numbers of eggs and sperm into the water. Colonies are hermaphroditic, in that each colony produces both eggs and sperm. Larvae settle on suitable hard substrates such as rock or dead coral and grow into colonies. Skeletal growth of colonies is relatively rapid compared to other reef-building corals. Prolific reproduction, rapid skeletal growth, and branching colony

morphology help *A. globiceps* successfully compete for space. However, resilience to disturbance is low, and populations that are frequently disturbed by warming-induced bleaching, storms, and other threats have high levels of mortality, rapid turnover, and high proportions of small colonies (Darling et al. 2012, Adjeroud et al. 2015, Kayal et al. 2015).

Habitat. *Acropora globiceps* is typically found on shallow forereefs (i.e., upper reef slopes), but may also occur in backreef areas such as the outer margins of reef flats, and within pools and lagoons (Appendix A). With regard to habitat requirements, *Acropora* species are among the most sensitive of all reef-building corals to sedimentation, as illustrated by reviews that consistently show lower *Acropora* cover with higher sedimentation of substrates (Fabricius 2005, Erftemeijer et al. 2012). Likewise, *Acropora* species are also among the most sensitive of all reef-building corals to poor water quality, as shown by inverse correlations of *Acropora* cover vs. turbidity and nutrients (De'ath and Fabricius 2008, Fabricius et al. 2012). Because *Acropora* have more restrictive habitat requirements than most other reef-building corals, they are projected to decline relatively rapidly as conditions worsen in the future (Caccaglia and van Woesik 2015, Nakabayashi et al. 2019).

Depth. The species is most common at 0 – 8 meters (m) of depth across its range (Veron 2000), but occurs to 20 m of depth in some locations. The depth distributions of *A. globiceps* in U.S. waters vary by archipelago, as described in section 2.1.4 above, based on the records in the Records Document (Appendix A).

Distribution and Occurrence in U.S. Waters. *Acropora globiceps* occurs in several dozen Veron ecoregions from the Chagos Archipelago to French Polynesia, and from the Northwestern Hawaiian Islands to New Caledonia (Veron et al. 2016, NMFS 2022). The species occurs in all five U.S. Pacific Islands jurisdictions, including American Samoa, Guam, CNMI, the Pacific Remote Islands Areas (PRIA), and Hawaii (Appendix A). The species' occupied area in terms of critical habitat is described in section 2.1.4 above.

2.2.2.2. *Acropora retusa*

Morphology, species identification, life history, habitat, depth, distribution, and occurrence in U.S. waters for *A. retusa* are summarized here, based on the more detailed species account in the draft RSR (NMFS 2022) and the Records Document (Appendix A).

Morphology. Colonies of *A. retusa* are flat plates with short, thick, digitate branches. Branches look spiky because radial corallites are variable in length, giving the species rougher-looking branches than other digitate *Acropora* species. Colonies are typically brown or green in color (Fenner and Burdick 2016, Fenner 2020). Like *A. globiceps* and other members of the "humilis group" of *Acropora* species, the thick, sturdy colonies of *A. retusa* are well-adapted for the shallow, high-energy habitats where they are most often found (Wallace 1999, Wallace et al. 2012).

Species Identification. *Acropora retusa* is not a well-studied species globally, and it is rare in U.S. waters. Based on the limited information currently available, and unlike *A. globiceps*, *A. retusa* does not necessarily have a typical and distinct appearance that distinguishes it from similar species (Fenner 2020, Burdick 2021, D. Burdick and D. Fenner, pers. comm, Aug-21). Thus, current species identification uncertainty is considered high for *A. retusa* (Appendix A).

Life History. There is little species-specific information on the life history of *A. retusa*. Generally, *Acropora* species reproduce by broadcast spawning, whereby colonies release large numbers of eggs and sperm into the water. Colonies are hermaphroditic, in that each colony produces both eggs and sperm. Larvae settle on suitable hard substrates such as rock or dead coral and grow into colonies (NMFS 2014).

Habitat and Depth. *Acropora retusa* most commonly occurs on upper reef slopes and tidal pools (Veron et al. 2016). Little depth information is available for this species, except from within U.S.

waters, as described in section 2.1.4 above, based on the records in the Records Document (Appendix A).

Distribution and Occurrence in U.S. Waters. *Acropora retusa* is known from several dozen Veron ecoregions from east Africa to French Polynesia (Veron et al. 2016). In U.S. waters, *A. retusa* occurs in American Samoa, but not in Guam, CNMI, most of PRIA, or Hawaii. Previous records of *A. retusa* in Guam, CNMI, and most of PRIA are confounded by species identification uncertainty (Appendix A). The species' occupied area in terms of critical habitat is described in section 2.1.4 above.

2.2.2.3. *Acropora speciosa*

Morphology, species identification, life history, habitat, depth, distribution, and occurrence in U.S. waters for *A. speciosa* are summarized here, based on the more detailed species account in the draft RSR (NMFS 2022) and the Records Document (Appendix A).

Morphology. Colonies of *A. speciosa* have flat tops of long, smooth branch tips, which are formed of very thin tubular corallites projecting upwards at various angles. Colonies are uniform grey-brown or pinkish in color (Fenner and Burdick 2016, Fenner 2020). Like *A. jacquelineae* and other members of the "loripes group" of *Acropora* species, branches are densely packed, and colonies are typically limited to deep or shaded water (Wallace 1999, Wallace et al. 2012) in protected environments (Veron et al. 2016).

Species Identification. Colonies of *A. speciosa* are similar to several other *Acropora* species, especially *A. jacquelineae*. Fenner (2020) describes the subtle differences that help distinguish the two species in the field. However, unequivocal distinction requires examination of a skeletal sample. Since this species cannot be reliably identified in the field even by trained experts, species identification uncertainty is considered to be high.

Life History. There is little species-specific information on the life history of *A. speciosa*. Generally, *Acropora* species reproduce by broadcast spawning, whereby colonies release large numbers of eggs and sperm into the water. Colonies are hermaphroditic, in that each colony produces both eggs and sperm. Larvae settle on suitable hard substrates such as rock or dead coral and grow into colonies (NMFS 2014).

Habitat and Depth. *Acropora speciosa* is typically found on walls, ledges, and reef slopes in deep water with little wave action (Brainard et al. 2011). The species occurs at 20 – 60 m of depth across its range (NMFS 2022). In U.S. waters, the depth distribution of *A. speciosa* is 20 – 50 m, as described in section 2.1.4 above, based on the records in the Records Document (Appendix A).

Distribution and Occurrence in U.S. Waters. *Acropora speciosa* is known from at least 42 Veron ecoregions from the Indian Ocean to French Polynesia (Veron et al. 2016, NMFS 2022). The species occurs in just one U.S. Pacific Islands jurisdiction, American Samoa (Appendix A). The species' occupied area in terms of critical habitat is described in section 2.1.4 above.

2.2.2.4. *Euphyllia paradivisa*

Morphology, species identification, life history, habitat, depth, distribution, and occurrence in U.S. waters for *E. paradivisa* are summarized here, based on the more detailed species account in the draft RSR (NMFS 2022) and the Records Document (Appendix A).

Morphology. Colonies of *E. paradivisa* form branching, separate corallites. Like all *Euphyllia* species, *E. paradivisa* has large polyps with tentacles that can be extended 10 – 20 cm (Eyal et al. 2016). Polyps have branching tentacles, an important characteristic for distinguishing it from other *Euphyllia* species. Color is typically pale greenish-grey with lighter tentacle tips (Fenner and Burdick 2016, Fenner 2020).

Species Identification. Since *E. paradivisa* colonies usually have a typical and distinct appearance (Fenner and Burdick 2016, Fenner 2020), current species identification uncertainty is considered low for this species (Appendix A).

Life History. *Euphyllia paradivisa* is a broadcast spawner, whereby both male and female gametes are released into the water column and fertilization takes place externally. Colonies are gonochoric, in that separate colonies produce eggs and sperm. Like other *Euphyllia* species, *E. paradivisa* has large polyps with tentacles that can be extended 10 – 20 cm, enhancing its capacity for feeding on plankton (NMFS 2022).

Habitat and Depth. *Euphyllia paradivisa* occurs mainly in low light environments protected from wave action across a wide depth range, such as shallow turbid bays and mesophotic depths. It is also sometimes found on shallow reefs in clear water. Colonies of *E. paradivisa* have been reported from a variety of substrates, including mud, sand and rubble, and rock (NMFS 2022). The species occurs at 5 – 75 m of depth across its range (NMFS 2022). In U.S. waters, the depth distribution of *E. paradivisa* is 20 – 50 m, as described in section 2.1.4 above, based on the records in the Records Document (Appendix A).

Distribution and Occurrence in U.S. Waters. *Euphyllia paradivisa* is known from at least 24 Veron ecoregions from the Red Sea to the Samoan Islands (Veron et al. 2016, NMFS 2022). The species occurs in just one U.S. Pacific Islands jurisdiction, American Samoa (Appendix A). The species' occupied area in terms of critical habitat is described in section 2.1.4 above.

2.2.2.5. *Isopora crateriformis*

Morphology, species identification, life history, habitat, depth, distribution, and occurrence in U.S. waters for *I. crateriformis* are summarized here, based on the more detailed species account in the draft RSR (NMFS 2022) and the Records Document (Appendix A).

Morphology. Colonies of *I. crateriformis* form flattened, solid, encrusting plates, usually with ripples on the surface. Most colonies are tan, but a few have tiny green spots which are the retracted polyps. Colonies are usually up to about 40 cm diameter but can be over 1 m diameter (Fenner and Burdick 2016, Fenner 2020).

Species Identification. Since *I. crateriformis* is the most common listed coral species in the main American Samoan islands, and its colonies usually have a typical and distinct appearance (Fenner and Burdick 2016, Fenner 2020), current species identification uncertainty is considered low for *I. crateriformis* (Appendix A).

Life History. The reproductive characteristics of *I. crateriformis* are unknown, but other *Isopora* species are brooders, whereby colonies release sperm but fertilization of eggs occurs internally. Colonies are hermaphroditic, in that each colony produces both eggs and sperm. Larvae settle on suitable substrates such as rock or dead coral and grow into colonies. Other life history characteristics of *I. crateriformis*, such as skeletal growth rate, are unknown (NMFS 2014).

Habitat and Depth. *Isopora crateriformis* is typically found on shallow forereefs (i.e., upper reef slopes), but may also occur on deeper forereefs, and in backreef areas with strong wave action such as the outer margins of reef flats (Appendix A). The species is most common at 0 – 12 m of depth but extends to approximately 20 m depth (NMFS 2022). The depth distribution of *I. crateriformis* in U.S. waters is described in section 2.1.4 above, based on the records in the Records Document (Appendix A). The species occurs in similar habitat as the "humilis group" of *Acropora* species (including, *A. globiceps* and *A. retusa*), and *Isopora* was a subgenus of *Acropora* until 2007 (see NMFS 2022 for taxonomic history). Thus, we assume that the general habitat requirements of *I. crateriformis* are like those for *A. globiceps*, which are described in the *A. globiceps* section above.

Distribution and Occurrence in U.S. Waters. *Isopora crateriformis* is known from at least 30 Veron ecoregions from the Coral Triangle to the Samoan Islands (Veron et al. 2016, NMFS 2022). The species occurs in just one U.S. Pacific Islands jurisdiction, American Samoa (Appendix A). The species' occupied area in terms of critical habitat is described in section 2.1.4 above.

2.3. Two Species Removed from Consideration

The 2020 proposed coral critical habitat rule was for seven listed Indo-Pacific coral species (*A. globiceps, A. jacquelineae, A. retusa, A. speciosa, E. paradivisa, I. crateriformis,* and *S. aculeata*), because we believed that the ranges of all seven species included U.S. waters (85 FR 76262; November 27, 2020). However, the currently available information indicates that no U.S. waters are within the occupied area for *A. jacquelineae* or *S. aculeata* (see detailed rationales in section 2.1.4 above), thus critical habitat does not apply to these two species. Therefore, the new proposed rule will be for five listed species, *A. globiceps, A. retusa, A. speciosa, E. paradivisa,* and *I. crateriformis*).

3. Critical Habitat Identification and Designation

Critical habitat represents the habitat essential for the species' recovery and provides for the conservation of listed species in several ways (81 FR 7413; February 11, 2016). Specifying the geographic location of critical habitat facilitates implementation of section 7(a)(1) of the ESA (16 U.S.C. § 1536(a)(1)) by identifying areas where Federal agencies may focus their conservation programs and use their authorities to further the purposes of the ESA. Designating critical habitat also provides significant regulatory protection by ensuring that the Federal government considers the effects of its actions in accordance with section 7(a)(2) of the ESA (§ 1536(a)(2)) and avoids or mitigates those actions that are likely to destroy or adversely modify critical habitat. This requirement is in addition to the section 7 requirement that Federal agencies ensure that their actions are not likely to jeopardize the continued existence of ESA-listed species. Critical habitat requirements do not apply to citizens engaged in activities on private land that do not involve a Federal action or nexus (such as Federal permitting or funding). However, designating critical habitat can help focus the efforts of other conservation partners (*e.g.*, State and local governments, individuals, and nongovernmental organizations).

Section 3(5)(A) of the ESA (16 U.S.C. §1532) defines critical habitat as (i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of the ESA, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protections; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the ESA, upon a determination by the Secretary that such areas are essential for the conservation of the species (16 U.S.C. § 1532(5)(A)). Conservation is defined in section 3 of the ESA as "to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary" (16 U.S.C. 1532(3)). Therefore, critical habitat is the habitat essential for the species' recovery. However, section 3(5)(C) of the ESA clarifies that, except in those circumstances determined by the Secretary, critical habitat shall not include the entire geographical area which can be occupied by the threatened or endangered species.

To identify and designate critical habitat, we considered information on the distribution of the five threatened Indo-Pacific corals, their major life stages, habitat requirements of those life stages, and conservation objectives that can be supported by identifiable physical or biological features. Our step-wise approach for identifying potential critical habitat areas for each of the threatened coral species was to determine the following: (1) the geographical area occupied by the species at the time of listing (i.e., the occupied area), including the depth range of the species within its occupied area (section 3.1 below); (2) the physical or biological features essential to the conservation of the species (section 3.2); (3) whether the physical or biological features within the specific areas may require special management considerations or protection (section 3.3); (4) the specific areas within the occupied area where the essential features occur (this step consists of four sub-steps, section 3.4); and (5) whether any unoccupied areas are essential to the conservation of the species (section 3.5). Each of these steps are described in the five sub-sections below.

In this report, the terms "occupied area," "specific area," and "critical habitat unit" each have distinct meanings. The terms "occupied area" and "specific area" are species-specific. The term "occupied area" is consistent with the definition of the "geographical area occupied by the species" in 50 CFR 424.02 and refers to the area that may generally be delineated around species' occurrences at the time of listing, as determined by the Secretary - i.e., range. Within each occupied area, "specific areas" are the areas containing the essential feature of critical habitat for the species. In contrast, the term "critical habitat unit" is not species-specific, and we use that term in this document to refer to all occupied areas and their constituent specific areas. The 18 critical habitat units considered in this document are named according to the particular island or offshore bank around, or on which, the coral habitat is located. For example, overlapping occupied areas for five listed coral species occur around Tutuila Island and its offshore banks, which is thus named the Tutuila and Offshore Banks Unit of coral critical habitat.

3.1. Occupied Areas and Depth Ranges

The definition of "occupied area" and the new methodology for determining which U.S. islands were within the occupied area for each listed species at the time of listing are described in Sections 2.1.2 and 2.1.4, respectively. The results from the application of the new methodology indicate that 18 islands were within the occupied area of *A. globiceps* at the time of listing, 4 islands for *A. retusa*, 1 island each for *A. speciosa* and *E. paradivisa*, and 3 islands for *I. crateriformis* (Table 2).

An additional facet of the occupied area for each listed species is its depth range, which refers to the range of depths that colonies of the species typically occur within (NMFS 2022). In this document, a depth of 0 meters refers to mean low water, defined as "the average of all the low water heights observed over the National Tidal Datum Epoch" by NOAA's Center for Operational Oceanographic Products and Services (https://tidesandcurrents.noaa.gov/datum_options.html, accessed Oct-21). For example, a depth range of 0 – 20 m refers to depths between mean low water (0 m) and 20 m below mean low water. The depth range for each of the five listed species is around each island is provided in Table 2 below, based on the detailed information in the Records Document (Appendix A).

Table 2. Areas considered for proposed coral critical habitat, including islands within the occupied area for each listed coral species (X) and depth range of the listed species around each island in meters, based on the results of the Records Document (Appendix A).

Island	*Ag**		*Ar*		*As*		*Ep*		*Ic*	
Tutuila & Offshore Banks	X	0-20	X	0-20	X	20-50	X	20-50	X	0-20
Ofu-Olosega	X	0-20	X	0-20	-	-	-	-	X	0-20
Ta'u	X	0-20	-	-	-	-	-	-	X	0-20
Rose Atoll	X	0-10	X	0-20	-	-	-	-	-	-
Guam	X	0-12	-	-	-	-	-	-	-	-
Rota	X	0-12	-	-	-	-	-	-	-	-
Aguijan	X	0-12	-	-	-	-	-	-	-	-
Tinian	X	0-12	-	-	-	-	-	-	-	-
Saipan	X	0-12	-	-	-	-	-	-	-	-
Farallon de Medinilla	X	0-12	-	-	-	-	-	-	-	-
Alamagan	X	0-12	-	-	-	-	-	-	-	-
Pagan	X	0-12	-	-	-	-	-	-	-	-
Maug Islands	X	0-12	-	-	-	-	-	-	-	-
Uracas	X	0-12	-	-	-	-	-	-	-	-
Palmyra Atoll	X	0-10	-	-	-	-	-	-	-	-
Johnston Atoll	X	0-10	-	-	-	-	-	-	-	-
Wake Atoll	X	0-10	X	0-20	-	-	-	-	-	-
French Frigate Shoals	X	0-10	-	-	-	-	-	-	-	-

**Ag = A. globiceps, Ar = A. retusa, As = A. speciosa, Ep = E. paradivisa, Ic = I. crateriformis.*

3.2. Physical or Biological Features Essential for Conservation

Within the geographical area occupied by the listed species (occupied areas), critical habitat consists of specific areas on which are found those physical and biological features (PBFs) essential to the conservation of the species and that may require special management considerations or protection. PBFs essential to the conservation of the species are defined as the features that occur in specific areas and that are essential to support the life-history needs of the species, including water characteristics, soil type, geological features, sites, prey, vegetation, symbiotic species, or other features. A feature may be a single habitat characteristic, or a more complex combination of habitat characteristics. Features may include habitat characteristics that support ephemeral or dynamic habitat conditions. Features may also be expressed in terms relating to principles of conservation biology, such as patch size, distribution distances, and connectivity (50 CFR 424.02).

In the final listing rule, we determined that the four corals were threatened under the ESA. This means that while the species are not in danger of extinction currently, they are likely to become so within the next several decades based on their current abundances and trends in abundance, distributions, and threats they experience now and in the future. The goal of an ESA listing is to first prevent extinction, and then to recover the species so they no longer meet the definition of a threatened species and no longer need the protections of the ESA. One of the first steps in recovery planning we conduct after listing a species is to develop a Recovery Outline, which provides an interim recovery program while a full recovery plan is developed and finalized. The Recovery Outline includes a Recovery Vision that can be summarized as follows: Populations of the 15 listed Indo-Pacific corals should be present throughout as much of their historical ranges as future environmental changes will allow, and may expand their ranges into new locations with more favorable habitat conditions in the future (https://www.fisheries.noaa.gov/resource/document/15-indo-pacific-coral-species-recovery-outline).

Recovery of these species will require conservation of the coral reef ecosystem through threats abatement to ensure a high probability of survival into the future. The key conservation objective that facilitates this Recovery Vision, and can be implemented through this critical habitat designation, is supporting successful reproduction and recruitment, and survival and growth of all life stages, by abating threats to the corals' habitats. In the final listing rule, we identified the major threats contributing to the four corals' extinction risk: ocean warming, disease, ocean acidification, trophic effects of reef fishing, nutrient enrichment, and sedimentation. Protecting essential features of the corals' habitat from these threats will facilitate the Recovery Vision.

Although there are many physical and biological features that characterize a coral reef habitat, we focus on a composite habitat feature that supports the conservation objective through its relevance to the major threats and threats impeding recovery: Reproductive, recruitment, growth, and maturation habitat. This essential feature is a complex combination of habitat characteristics that support normal functions of all life stages of the corals. Due to corals being sessile for most of their entire life cycle, they carry out most demographic functions in one location. Thus, we have identified sites with a combination of substrate and water quality characteristics as the essential feature. Appropriate attachment substrate, in association with warm, aragonite-supersaturated, oligotrophic, clear marine water, is essential to reproduction and recruitment, survival, and growth of all life stages of all four species of coral. The substrate can be impacted by ocean acidification, trophic effects of reef fishing, nutrient enrichment, and sedimentation, and the associated water column can be impacted by ocean warming, ocean acidification, nutrient enrichment, sedimentation, and contamination.

Based on the best scientific information available we identify the following physical feature essential to the conservation of the four corals for which critical habitat is being considered. Our proposed definition for the essential feature is:

Reproductive, recruitment, growth, and maturation habitat. Sites that support the normal function of all life stages of the corals, including reproduction, recruitment, and maturation. These sites are natural, consolidated hard substrate or dead coral skeleton, which is free of algae and sediment at the appropriate scale at the point of larval settlement or fragment reattachment, and the associated water column. Several attributes of these sites determine the quality of the area and influence the value of the associated feature to the conservation of the species:

(1) The presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or the presence of crustose coralline algae;
(2) Reefscape with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae;
(3) Marine water with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support all demographic functions; and
(4) Marine water with levels of anthropogenically-introduced chemical contaminants that do not preclude or inhibit any demographic function.

3.2.1. Substrate Component

Reef-building corals require exposed natural consolidated hard substrate for the settlement and recruitment of larvae or asexual fragments. Substrate provides the physical surface and space necessary for settlement of coral larvae, a stable environment for metamorphosis of the larvae into the primary polyp, growth of juvenile and adult colonies, and re-attachment of fragments. Larvae can settle and attach to dead coral skeleton (Brainard et al. 2011). Several attributes have been shown to influence coral larval settlement. Positive cues include the presence of crustose coralline algae (Heyward and Negri 1999), biofilms (Webster et al. 2004), and cryptic habitat such as crevices and holes (Nozawa 2008). Attributes that negatively affect settlement include presence of sediment and algae (Vermeij et al. 2009). Coral recruitment tends to be greater when macroalgal biomass is low (Birrell et al. 2005). In addition to preempting space for coral larvae settlement, many fleshy macroalgae produce substances that may inhibit larval settlement, recruitment, and survival (Jompa and McCook 2003). Furthermore, algal turfs can trap sediments (Purcell and Bellwood 2001), which then create the potential for algal turfs and sediments to act in combination to hinder coral settlement (Birrell et al. 2005, Tebbett and Bellwood 2019).

Presence and amount of sediment is a particularly important determinant of the quality of substrate for reef-building coral habitat. Sediments enter the reef environment through many processes that are natural or anthropogenic in origin, including erosion of the coastline, resuspension of bottom sediments, terrestrial run-off, and nearshore dredging for coastal construction projects and navigation purposes. The rate of sedimentation affects reef distribution, community structure, growth rates, and coral recruitment (Dutra et al. 2006). Sediment accumulation on dead coral skeletons and exposed hard substrate reduces the amount of available substrate for coral larvae settlement and fragment reattachment (Rogers 1990). Sediment also impedes settlement of coral larvae (Babcock and Smith 2002). The deeper the sediment, the longer it may take for natural waves and currents to remove the sediment from the settlement substrate. Sediment texture also affects the severity of impacts to corals and recruitment substrate. Fine grain sediments have greater negative effects to live coral tissue and to recruitment substrate (Erftemeijer et al. 2012). Accumulation of sediments is also a major cause of mortality in coral recruits (Fabricius et al. 2003). In some instances, if mortality of coral recruits does not occur under heavy sediment conditions, then settled coral planulae may undergo reverse metamorphosis and die in the water column (Te 1992). Accumulation of sediment can smother living corals and cover dead coral skeleton and exposed hard substrate (Fabricius 2005, Erftemeijer et al. 2012). Sedimentation, therefore, impacts the health and survivorship of all life stages of corals (i.e., adults, fragments, larvae, and recruits).

The literature provides several recommendations on maximum sediment levels for coral reefs (i.e., levels that managers should strive to stay under). De'ath and Fabricius (2008) and GBRMPA (2010) recommend that sediment levels on the Great Barrier Reef (GBR) be less than a mean annual sedimentation rate of 3 mg/cm2/day, and less than a daily maximum of 15 mg/cm2/day. Rogers (1990) recommends that sediment levels on coral reefs globally be less than a mean maximum of 10 mg/cm2/day to maintain healthy corals, and also notes that moderate to severe effects on corals are generally expected at mean maximum sedimentation rates of 10 to 50 mg/cm2/day, and severe to catastrophic effects at >50 mg/cm2/day. Similarly, Erftemeijer et al. (2012) suggests that moderate to severe effects to corals are expected at mean maximum sediment levels of >10 mg/cm2/day, and catastrophic effects at >50 mg/cm2/day. Nelson et al. (2016) suggests that sediment depths of >0.5 cm result in substantial stress to most coral species, and that sediment depths of >1.0 cm are lethal to most coral species. The above generalizations are for coral reef communities and ecosystems, rather than individual species.

Sublethal effects of sediment to corals potentially occur at much lower levels than mortality. Sublethal effects include reduced growth, lower calcification rates and reduced productivity, bleaching, increased susceptibility to diseases, physical damage to coral tissue and reef structures (breaking, abrasion), and reduced regeneration from tissue damage (see reviews by Rogers 1990, Fabricius et al. 2005, Erftemeijer et al. 2012, and Browne et al. 2015). Erftemeijer et al. (2012) states that sublethal effects for coral species that are sensitive, intermediate, or tolerant to sediment (i.e., most reef-building coral species) occur at mean maximum sedimentation rates of between <10 and 200 mg/cm^2/day, depending on species, exposure duration, and other factors.

3.2.2. Water Quality Component

The substrate characterized above must be associated with water that also supports all life functions of corals that are carried out at the site. Water quality conditions fluctuate greatly over various spatial and temporal scales in natural reef environments (Kleypas et al. 1999). However, certain levels of particular parameters must exist on average to provide the conditions conducive to coral growth, reproduction and recruitment (Tisthammer et al. 2021). Corals may tolerate and survive in conditions outside these levels, depending on the local conditions to which they have acclimatized and the intensity and duration of any deviations from conditions conducive to a particular coral's growth, reproduction and recruitment. Deviations from tolerance levels of certain parameters result in direct negative effects on all life stages. As described in this Information Report, corals thrive in warm, clear, nutrient-poor marine waters with calcium carbonate concentrations that allow for symbiont photosynthesis, coral physiological processes and skeleton formation. This water must also have low to no levels of contaminants that would interfere with normal functions of all life stages. Water quality that supports normal functions of corals is adversely affected by ocean warming, ocean acidification, nutrient enrichment, sedimentation and contamination.

3.2.2.1. *Seawater Temperature*

Seawater temperature is a particularly important limiting factor of coral habitat, and consequently ocean warming is one of the most important threats to reef-building corals. Corals occur in a wide temperature range across geographic locations (15.7°C–35.5°C weekly average and 21.7–29.6°C annual average; Guan et al. 2015), but only thrive in areas with mean temperatures in a narrow range (typically 25°C–29°C) as indicated by the global distribution of coral reefs (Kleypas et al. 1999, Brainard et al. 2011). Short-term exposures (days) to temperature increases of a few degrees (i.e., 3°C–4°C increase above mean maximum summer temperature) or long-term exposures (several weeks) to minor temperature increases (i.e., 1°C–2°C above mean maximum summer temperature) can cause significant thermal stress and mortality to most coral species (Jokiel and Coles 1990, Berkelmans and Willis, 1999). In addition to coral bleaching, elevated seawater temperatures impair coral fertilization and settlement (Nozawa and Harrison 2007) and cause increases in coral disease (Miller et al. 2009).

Effects of elevated seawater temperatures are well-studied for reef-building corals, and many approaches have been used to estimate temperature thresholds for coral bleaching and mortality (see reviews by Brown 1997, Berkelmans 2002, Coles and Brown 2003, Jokiel 2004, Baker et al. 2007, Jones 2008, Coles and Riegl 2013). The tolerance of corals to temperature is species-specific (van Woesik et al. 2011, Vega-Rodriguez 2016) and depends on suites of other variables that include acclimation temperature, aragonite saturation state, dissolved inorganic nitrogen (Fabricius 2005, Cunning and Baker 2012, Wooldridge 2013); and physical, physiological, and chemical stressors, including suspended sediments and turbidity (Anthony et al. 2007, Woods et al. 2016); trace metals such as copper (Negri and Hoogenboom 2011, Woods et al. 2016), ultraviolet radiation (Anthony et al. 2007), salinity, nitrates, and phosphates (Negri and Hoogenboom 2011).

Ocean warming is one of the most significant threats to the four corals for which we are proposing to designate critical habitat. Mean seawater temperatures in reef-building coral habitat in the Indo-Pacific have increased during the past few decades, and are predicted to continue to rise between now and 2100 (IPCC 2013). The primary observable coral response to ocean warming is bleaching of adult coral colonies, wherein corals expel their symbiotic zooxanthellae in response to stress (Brown 1997). Even so, evaluating the effects that changes in water temperatures have on the conservation value of coral habitat is very complex and contextually-driven, and simple numeric effect thresholds are not easily assigned to listed corals to establish when stress responses occur.

For many corals, an episodic increase of only 1°C–2°C above the normal local seasonal maximum ocean temperature can induce bleaching (Hoegh-Guldberg et al. 2007, Jones 2008). Corals can withstand mild to moderate bleaching; however, severe, repeated, or prolonged bleaching can lead to colony death (Brown 1997). In addition to coral bleaching, other effects of ocean warming detrimentally affect virtually every life-history stage in reef-building corals. Impaired fertilization and developmental abnormalities (Negri and Heyward 2000), mortality, and impaired settlement success (Nozawa and Harrison 2007) have all been documented. Increased seawater temperature may also act synergistically with coral diseases to reduce coral health and survivorship (Bruno and Selig 2007). Coral disease outbreaks often have either accompanied or immediately followed bleaching events (Jones et al. 2004, Miller et al. 2009, Howells et al. 2020). Outbreaks also follow seasonal patterns of high seawater temperatures (Willis et al. 2004).

Coles and Brown (2003) defined a general bleaching threshold for reef-building corals as increases in seawater temperatures of 1–3°C above maximum annual mean temperatures at a given location. GBRMPA (2010) defined a general "trigger value" for bleaching in reef-building corals as increases in seawater temperatures of no more than 1°C above maximum annual mean temperatures at a given location. Duration of exposure to elevated temperatures determines the extent of bleaching, thus several methods have been developed to integrate duration into bleaching thresholds, including the number of days, weeks, or months of elevated temperatures (Berkelmans 2002, Eakin et al. 2009). NOAA's Coral Reef Watch Program utilizes the Degree Heating Week method (Glynn and D'Croz 1990, Eakin et al. 2009), which defines a general bleaching threshold for reef-building corals as seawater temperatures of 1°C above maximum monthly mean at a given location for four consecutive weeks (NOAA 2021).

These general thresholds were developed for coral reef communities and ecosystems, rather than individual species. Many of these studies are community or ecosystem-focused and do not account for species-specific responses to changes in seawater temperatures, and instead are focused on long-term climatic changes and large-scale impacts (e.g., coral reef distribution, persistence).

In summary, temperature deviations from local averages prevent or impede successful completion of all life history stages of the listed coral species. Identifying temperatures at which the conservation value of habitat for listed corals may be affected is inherently complex and influenced by taxa, exposure duration, and other factors.

3.2.2.2. *Aragonite Saturation State*

Carbonate ions (CO_3^{2-}) are used by many marine organisms, including corals, to build calcium carbonate skeletons. For corals, the mineral form of calcium carbonate in their skeletons is aragonite. The more carbonate ions there are dissolved in seawater, the easier it is for corals to build their aragonite skeletons. The metric used to express the relative availability of calcium and carbonate ions is the aragonite saturation state (Ω_{arg}). Thus, the lower the Ω_{arg} of seawater, the lower the abundance of carbonate ions, and the more energy corals must expend for skeletal calcification, and vice versa (Cohen and Holcomb 2009). At saturation states between 1 and 20, marine organisms can create calcium carbonate shells or skeletons using a physiological calcifying mechanism and the expenditure of energy. The aragonite saturation state varies greatly within and across coral reefs and through daily cycles with temperature, salinity, pressure, and localized biological processes such as photosynthesis, respiration, and calcification by marine organisms (Gray et al. 2012, Shaw et al. 2012a, McMahon et al. 2013).

Coral reefs form in an annually-averaged saturation state of 4.0 or greater for optimal calcification, and an annually-averaged saturation state below 3.3 will result in reduced calcification at rates insufficient to maintain net positive reef accretion, resulting in loss of reef structure (Guinotte et al. 2003, Hoegh-Guldberg et al. 2007). Guinotte et al. (2003) classified the range of aragonite saturation states between 3.5-4.0 as "adequate" and <3 as "extremely marginal." Thus, aragonite saturation state between 3 and 4 is likely necessary for coral calcification. But, generally, seawater Ω_{arg} should be 3.5 or greater to enable maximum calcification of reef-building corals, and average Ω_{arg} in most coral reef areas is currently in that range (Guinotte et al. 2003). Further, Kleypas et al. (1999) concluded that a general threshold for Ω_{arg} occurs near 3.4, because only a few reefs occur where saturation is less than this. Guan et al. (2015) found that the minimum aragonite saturation observed where coral reefs currently occur is 2.82; however, it is not known if those locations hosted live accreting corals. These general characterizations and thresholds were identified for coral reef communities and ecosystems, rather than individual species.

Ocean acidification is a term referring to changes in ocean carbonate chemistry, including a drop in the pH of ocean waters, that is occurring in response to the rise in the quantity of atmospheric CO_2 and the partial pressure of CO_2 (pCO_2) absorbed in oceanic waters (Caldeira and Wickett 2003). As pCO_2 rises, oceanic pH declines through the formation of carbonic acid and subsequent reaction with water resulting in an increase of free hydrogen ions. The free hydrogen ions react with carbonate ions to produce bicarbonate, reducing the amount of carbonate ions available, and thus reducing the aragonite saturation state (Brainard et al. 2011, Jokiel, 2015).

A variety of laboratory studies conducted on corals and coral reef organisms (e.g., Langdon and Atkinson 2005) consistently show declines in the rate of coral calcification and growth with rising pCO_2, declining pH, and declining carbonate saturation state. Laboratory experiments have also shown that skeletal deposition and initiation of calcification in newly settled corals is reduced by declining aragonite saturation state (Albright et al. 2008, Cohen et al., 2009). Field studies from a variety of coral locations in the Caribbean, Indo-Pacific, and Red Sea have shown a decline in linear extension rates (Schneider and Erez 2006, Bak et al. 2009, De'ath et al. 2009, Tanzil et al., 2009). Reduced calcification and slower growth will mean slower recovery from breakage, whether natural (hurricanes and storms) or human (breakage from vessel groundings, anchors, fishing gear, etc.), or mortality from a variety of disturbances. Slower growth also implies even higher rates of mortality for newly settled corals due to the longer time it will take to reach a colony size that is no longer vulnerable to overgrowth competition, sediment smothering, and incidental predation. Reduced calcification and slower growth means more time to reach reproductive size and reduces sexual and asexual reproductive potential. Increased pCO_2 coupled with increased sea surface temperature can lead to even lower rates of calcification, as found in the meta-analysis by Kornder et al. (2018). Therefore, ocean acidification is one of the most important threats to reef-building corals (Brainard et al. 2011, Jokiel, 2015).

In summary, aragonite saturation reductions prevent or impede successful completion of all life history stages of the listed coral species. Identifying a declining aragonite saturation state at which the conservation value of habitat for listed corals may be affected is inherently complex and influenced by taxa, exposure duration, acclimatization to localized nutrient regimes, and other factors.

3.2.2.3. *Nutrients*

Nitrogen and phosphorous are two of the main nutrients that affect the suitability of coral habitat (Fabricius et al. 2005, Fabricius, 2005). These two nutrients occur as different compounds in coral reef habitats and are necessary in low levels for normal reef function. Dissolved inorganic nitrogen and dissolved inorganic phosphorus in the forms of nitrate (NO_3) and phosphate ($PO4_3$) are particularly important for photosynthesis, with dissolved organic nitrogen also providing an important source of nitrogen, and are the dominant forms of nitrogen and phosphorous in coral reef waters. Nutrients are a major component of land-based sources of pollution (LBSP), one of the most important threats to reef-building corals (Brainard et al. 2011). Excessive nutrients affect corals through two main mechanisms: direct impacts on coral physiology such as reduced fertilization and growth (Ferrier-Pages et al., 2000, Harrison and Ward 2001), and indirect effects through nutrient-stimulation of other community components (e.g., macroalgae seaweeds, turfs/filamentous algae, cyanobacteria, and filter feeders) that compete with corals for space on the reef (79 FR 53851, September 10, 2014). The latter also affects the quality of recruitment substrate discussed previously. The physiological response a coral exhibits to an increase in nutrients mainly depends on intensity and duration. A short duration of a large increase in a nutrient may result in a severe adverse response, just as a chronic, lower concentration might.

Most coral reefs occur where annual mean nutrient levels are low. Kleypas et al. (1999) analyzed dissolved nutrient data from nearly 1,000 coral reef sites, finding mean values of 0.25 micromoles per liter (µmol/l) for NO_3, and 0.13 µmol/l for PO_4. Over 90 percent of the sites had mean NO_3 values of <0.6 µmol/l, and mean PO_4 values of <0.2 µmol/l (Kleypas et al. 1999). Several authors, including Bell and Elmetri (1995) and Lapointe (1997) have proposed threshold values of 1.0 µmol/l for NO_3, and 0.1-0.2 µmol/l for PO_4, above which NO_3 and PO_4 are excessive (eutrophic). However, concentrations of dissolved nutrients are poor indicators of coral reef status, and the concept of a simple threshold concentration that indicates eutrophication has little validity (McCook et al. 1999). One reason for that is because corals are exposed to nutrients in a variety of forms, including dissolved nitrogen (e.g., NO_3), dissolved phosphorus (e.g., $PO4_3$), particulate nitrogen (PN), and particulate phosphate (PP). Since the dissolved forms are assimilated rapidly by phytoplankton, and most of the nitrogen and phosphorus discharged in terrestrial runoff is in the particulate forms, PN and PP are the most common bio-available forms of nutrients for corals on coastal zone reefs (Cooper and Fabricius 2007). Thus, De'ath and Fabricius (2008) and GBRMPA (2010) provide general recommendations on maximum annual mean values for PN and PP of 1.5 µmol/l PN and 0.09 µmol/l PP for coastal zone reefs. These generalizations are for coral reef communities and ecosystems, rather than individual species.

As noted above, identifying nutrient concentrations at which the conservation value of habitat for listed corals may be affected is inherently complex and influenced by taxa, exposure duration, and acclimatization to localized nutrient regimes, and other factors.

3.2.2.4. *Water Clarity/Turbidity*

Water clarity or transparency is a key factor for marine ecosystems, and it is the best explanatory variable for a range of bioindicators of reef health (Fabricius et al. 2012). Water clarity affects the light availability for photosynthetic organisms and food availability for filter feeders. Corals depend upon their symbiotic algae for nutrition and thus depend on light availability for algal photosynthesis. Reduced water clarity is determined by the presence of particles of sediment, organic matter, and/or plankton in the water, and so is often associated with elevated sedimentation and/or nutrients. Water clarity can be measured in multiple ways, including, percent of solar irradiance at depth, Secchi depth (the depth in the water column at which a black and white disk is no longer visible), and Nephelometric Turbidity Unit (NTU – measure of light scatter based on particles in the water column). Reef-building corals naturally occur across a broad range of water clarity levels from very turbid waters on enclosed reefs near river mouths (Browne et al. 2012) to very clear waters on offshore barrier reefs, and many intermediate habitats such as open coastal and mid-shelf reefs (GBRMPA 2010). Coral reefs appear to thrive in extremely clear areas where Secchi depth is ≥ 15 m or light scatter is < 1 NTU (De'ath and Fabricius 2010). Typical levels of total suspended solids (TSS) in reef environments are less than 10 mg/L (Rogers 1990). The minimum light level for reef development is about 6-8 percent of surface irradiance (Fabricius et al. 2014).

For a particular coral colony, water clarity levels tolerated likely depend on several factors, including species, life history stage, spatial variability, and temporal variability. For example, colonies of a species occurring on fringing reefs around high volcanic islands with extensive groundwater inputs are likely to be better acclimatized or adapted to higher turbidity than colonies of the same species occurring on offshore barrier reefs or around atolls with very little or no groundwater inputs. In some cases, corals occupy naturally turbid habitats (McClanahan and Obura 1997, Anthony and Larcombe 2000, Te 2001) where they may benefit from the reduced amount of UV radiation to which they are exposed (Zepp et al. 2008). Reductions in water clarity affect light availability for corals. As turbidity and nutrients increase, thus decreasing water clarity, reef community composition shifts from coral dominated to macroalgae to ultimately heterotrophic animals (Fabricius et al. 2012). Light penetration is diminished by suspended abiotic and biotic particulate matter (esp. clay and silt-sized particles) and some dissolved substances (Fabricius et al. 2014). The availability of light decreases directly as a function of particle concentration and water depth, but also depends on the nature of the suspended particles. Fine clays and organic particles are easily suspended from the sea floor, reducing light for prolonged periods while undergoing cycles of deposition and resuspension. Suspended fine particles also carry nutrients and other contaminants (Fabricius et al. 2013). Increased nutrient runoff into semi-enclosed seas accelerates phytoplankton production to the point that it also increases turbidity and reduces light penetration, and can also settle on colony surfaces. In areas of nutrient enrichment, light for benthic organisms can be additionally severely reduced by dense stands of large fleshy macroalgae shading adjacent corals (Fabricius 2005).

The literature provides several recommendations on maximum turbidity levels for coral reefs (i.e., levels that managers should strive to stay under). GBRMPA (2010) recommends minimum mean annual water clarity, or “trigger values”, in Secchi distances for the GBR depending on habitat type: For enclosed coastal reefs, 1.0-1.5 m; for open coastal reefs and mid-shelf reefs, 10 m; and for offshore reefs, 17 m. De'ath and Fabricius (2008) recommend a minimum mean annual water clarity trigger value in Secchi distance averaged across all GBR habitats of 10 m. Bell and Elmetri (1995) recommend a maximum value of 3.3 mg/L TSS across all GBR habitats. Thomas et al. (2003) recommends a maximum value of 10 mg/L averaged across all Papua New Guinea coral reef habitats. Larcombe et al. (2001) recommend a maximum value of 40 mg/L TSS for GBR “marginal reefs”, i.e., reefs close to shore with high natural turbidity levels. Guan et al. (2015) recommends a minimum light intensity (μmol photons second/m2) of 450 μmol photons second/m2 globally for coral reefs. The above generalizations are for coral reef communities and ecosystems, rather than individual species.

A coral’s response to a reduction in water clarity is dependent on intensity and duration. For example, corals exhibited partial mortality when exposed to 476 mg/L TSS (Bengtsson et al. 1996) for 96 hours but had total mortality when exposed to 1000 mg/L TSS for 65 hours (Thompson and Bright 1980). Depending on the duration of exposure, most coral species exhibited sublethal effects when exposed to turbidity levels between 7 and 40 NTU (Erftemeijer et al. 2012). The most tolerant coral species exhibited decreased growth rates when exposed to 165 mg/L TSS for 10 days (Rice and Hunter 1992). Turbidity reduces water clarity and so reduces the maximum depth at which corals can live, making deeper habitat unsuitable (Fabricius 2005). Existing data suggest that coral reproduction and settlement are more highly sensitive to changes in water clarity than adult survival and these functions are dependent on clear water. Suspended particulate matter reduces fertilization and sperm function (Ricardo et al. 2015) and strongly inhibits larvae survival, settlement, recruitment, and juvenile survival (Fabricius 2005).

In summary, water clarity deviations from local averages prevent or impede successful completion of all life history stages of the listed coral species. Identifying turbidity levels at which the conservation value of habitat for listed corals may be affected is inherently complex and influenced by taxa, exposure duration, and acclimatization to localized nutrient regimes, and other factors.

3.2.2.5. *Contaminants*

The water column may include levels of anthropogenically-introduced chemical contaminants that do not prevent or impede successful completion of all life history stages of the listed coral species. For the purposes of this rule, "contaminants" is a collective term to describe a suite of anthropogenically-introduced chemical substances in water or sediments that may adversely affect corals. The study of the effects of contaminants on corals is a relatively new field and information on sources and ecotoxicology is incomplete. The major groups of contaminants that have been studied for effects to corals include heavy metals (also called trace metals), pesticides, and hydrocarbons. Other organic contaminants, such as chemicals in personal care products, polychlorinated biphenyl, and surfactants, have also been studied. Contaminants may be delivered to coral reefs via point or non-point sources. Specifically, contaminants enter the marine environment through wastewater discharge, shipping, industrial activities, and agricultural and urban runoff. These contaminants can cause negative effects to coral reproduction, development, growth, photosynthesis, and survival.

Heavy metals (e.g., copper, cadmium, manganese, nickel, cobalt, lead, zinc, and iron) can be toxic at concentrations above naturally-occurring levels. Heavy metals are persistent in the environment and can bioaccumulate. Metals are adsorbed to sediment particles, which can result in their long-distance transport away from sources of pollution. Corals incorporate metals in their skeleton and accumulate them in their soft tissue (Al-Rousan et al. 2012, Barakat et al. 2015). Although heavy metals can occur in the marine environment from natural processes, in nearshore waters they are mostly a result of anthropogenic sources (e.g., wastewater, antifouling and anticorrosive paints from marine vessels and structures, land filling and dredging for coastal expansion, maritime activities, inorganic and organic pollutants, crude oil pollution, shipping processes, industrial discharge, agricultural activities) and are found near cities, ports, and industrial developments.

The effects of copper on corals include physiological impairment, impaired photosynthesis, bleaching, reduced growth, and DNA damage (Bielmyer et al. 2010, Schwarz et al. 2013). Effects to fertilization, larval development, larval swimming behavior, metamorphosis, and larval survival have also been documented (Rumbold and Snedaker 1997, Negri and Hoogenboom 2011, Kwok and Ang 2013, Puisay et al. 2015, Reichelt-Brushett and Hudspith 2016). Toxicity of copper was found to be higher when temperatures are elevated (Negri and Hoogenboom 2011). Nickel and cobalt can also have negative effects on corals, such as reduced growth and photosynthetic rates (Biscere et al. 2015), and reduced fertilization success (Reichelt-Brushett and Hudspith 2016). Chronic exposure of corals to higher levels of iron may significantly reduce growth rates Ferrier-Pages et al. (2001). Further, iron chloride has been found to cause oxidative DNA damage to coral larvae (Vijayavel et al. 2012).

Polycyclic aromatic hydrocarbons (PAHs) are found in fossil fuels such as oil and coal and can be produced by the incomplete combustion of organic matter. PAHs disperse through non-point sources such as road run-off, sewage, and deposition of particulate air pollution. PAHs can also disperse from point sources such as oil spills and industrial sites. Studies have found effects of oil pollution on corals include growth impairments, mucus production, and decreased reproduction, especially at increased temperature (Kegler et al. 2015). Hydrocarbons have also been found to affect early life stages of corals. Oil-contaminated seawater reduced settlement of *Orbicella faveolata* and of *Agaricia humilis* and was more severe than any direct or latent effects on survival (Hartmann et al. 2015). Natural gas (water accommodated fraction) exposure resulted in abortion of larvae during early embryogenesis and early release of larvae during late embryogenesis, with higher concentrations of natural gas yielding higher adverse effects (Villanueva et al. 2011). Oil, dispersant, and a combination of oil and dispersant on significantly decreased settlement and survival of *Porites astreoides* and *O. faveolata* larvae (Goodbody-Gringley et al. 2013).

Anthracene (a PAH used in dyes, wood preservatives, insecticides, and coating materials) exposure to apparently healthy and diseased (Caribbean yellow band disease) fragments of *O. faveolata* reduced activity of enzymes important for protection against environmental stressors in the diseased colonies (Montilla et al. 2016). The results indicated that diseased tissues might be more vulnerable to the exposure to PAHs such as anthracene than apparently healthy corals. PAH concentrations similar to those after an oil spill inhibited metamorphosis of *Acropora tenuis* larvae and sensitivity increased when co-exposed to “shallow reef” UV light levels (Negri et al. 2016).

Pesticides include herbicides, insecticides, and antifoulants used on vessels and other marine structures. Pesticides can affect non-target marine organisms like corals and their zooxanthellae. Diuron, an herbicide, decreased photosynthesis isolated zooxanthellae (Shaw et al. 2012b). Irgarol, an additive in copper-based antifouling paints, significantly reduced settlement in *Porites hawaiiensis* (Knutson et al. 2012). *Porites astreoides* larvae exposed to two major mosquito pesticide ingredients, naled and permethrin, for 18-24 hours showed differential responses. Concentrations of 2.96 μg/L or greater of naled significantly reduced larval survivorship. However, reduced larval survivorship was not detected in exposure of up to 6.0 μg/L of permethrin. Larval settlement, post-settlement survival, and zooxanthellae density were not impacted by any treatment (Ross et al. 2015).

Benzophenone-2 (BP-2) is a chemical additive to personal care products (e.g., shampoo, body lotions, soap, detergents), product coatings (oil-based paints, polyurethanes), acrylic adhesives, and plastics that protects against damage from ultraviolet light. It is released into the ocean through municipal and boat/ship wastewater discharges, landfill leachates, residential septic fields, and unmanaged cesspits. BP-2 is a known endocrine disruptor and a DNA mutagen, and its effects are worse in the light. It caused deformation of *Stylophora pistillata* larvae changing them from a motile planktonic state to a deformed sessile condition at low concentrations. It also caused increasing larval bleaching with increasing concentration (Downs et al. 2014). Benzophenone-3 (BP-3; oxybenzone) is an ingredient in sunscreen and personal care products (e.g., hair cleaning and styling products, cosmetics, insect repellent, soaps) that protects against damage from ultraviolet light. It enters the marine environment through swimmers and municipal, residential, and boat/ship wastewater discharges and can cause DNA mutations. Oxybenzone is a skeletal endocrine disruptor, and it caused larvae of *S. pistillata* to encase themselves in their own skeleton. Exposure to oxybenzone transformed *S. pistillata* larvae from a motile state to a deformed, sessile condition. Larvae exhibited an increasing rate of coral bleaching in response to increasing concentrations of oxybenzone (Downs et al. 2016).

Polychlorinated biphenyls (PCBs) are environmentally stable, persistent organic pollutants that have been used as heat exchange fluids in electrical transformers and capacitors, and as additives in paint, carbonless copy paper, and plastics. They can be transported globally through the atmosphere, water, and food web. A study of the effects of the PCB Aroclor 1254 on the scleractinian coral *S. pistillata* found no effects on coral survival, photosynthesis, or growth; however, the exposure concentration and duration may alter the expression of certain genes involved in important cellular functions (Chen et al. 2012).

Surfactants are used as detergents and soaps, wetting agents, emulsifiers, foaming agents, and dispersants. Linear alkylbenzene sulfonate (LAS) is one of the most common surfactants in use. Biodegradation of surfactants can occur within a few hours to several days, but significant proportions of surfactants attach to suspended solids and remain in the environment. This sorption of surfactants onto suspended solids depends on environmental factors such as temperature, salinity, or pH. Exposure of *Pocillopora verrucosa* to LAS resulted in tissue loss on fragments. The combined effects of LAS exposure with increased temperature (+3°C to 31°C) resulted in greater tissue loss than LAS exposure alone (Kegler et al. 2015).

In summary, there are multiple chemical contaminants that prevent or impede successful completion of all life history stages of the listed coral species. Identifying contaminant levels at which the conservation value of habitat for listed corals may be affected is inherently complex and influenced by taxa, exposure duration, and other factors.

3.2.3. Artificial Substrates and Managed Areas Not Included

Artificial substrates are typically man-made or introduced substrates that are not naturally occurring to the area. Examples include, but are not necessarily limited to, fixed and floating structures, such as aids-to-navigation (AToNs), seawalls, wharves, boat ramps, bridge supports, fishpond walls, pipes, wrecks, mooring balls, docks, and aquaculture cages. Only natural substrates provide the quality and quantity of recruitment habitat necessary for the conservation of threatened corals. Artificial substrates are generally less functional than natural substrates in terms of supporting healthy and diverse coral reef ecosystems (USFWS 2004, Edwards and Gomez 2007). Therefore, we conclude that existing artificial substrates do not provide the essential feature necessary for the conservation of the four listed corals for which we are proposing to designate critical habitat.

Likewise, existing “managed areas” do not provide the essential feature. “Managed areas,” for the purposes of this proposed rule, are specific areas where the substrate has been persistently disturbed by planned management authorized by local, state, or Federal governmental entities at the time of critical habitat designation, and expectations are that the areas will continue to be periodically disturbed by such management. Examples include, but are not necessarily limited to, all harbors and their entrance channels, navigation channels, turning basins, and berthing areas that are periodically dredged or maintained. These managed areas are not under consideration for critical habitat designation.

While artificial substrates and managed areas may temporarily provide hard substrate for coral settlement and growth over short periods, the periodic nature of direct human disturbance renders them poor environments for coral growth and survival over time. Therefore, they do not provide the essential feature, and therefore are not essential to the conservation of the listed species. Existing artificial substrates and managed areas within each of the 18 critical habitat units are described in section 3.4 below, and listed in Appendix B to this report. The same does not apply to any proposed or planned artificial substrates and managed areas, and their footprints are not included in section 3.4 below or in Appendix B.

3.3. Special Management Considerations

Specific areas within the geographical area occupied by a species may be designated as critical habitat only if they contain essential features that “may require special management considerations or protection” (16 U.S.C. 1532(5)(A)(i)(II). Special management considerations or protection are any “methods or procedures useful in protecting physical or biological features for the conservation of listed species” (50 CFR 424.02). Only those essential features that may need special management considerations or protection are considered further. We may conduct this analysis of the potential need for special management considerations or protection at the scale of all specific areas, but we may also do so within each specific area. We conducted our analysis at the scale of all specific areas due to the global nature of the threats related to climate change and their effects on the essential feature.

The essential feature is particularly susceptible to impacts from human activity because of the relatively shallow water depth range (<50 m) the corals inhabit. The proximity of this habitat to coastal areas subjects this feature to impacts from multiple activities in American Samoa, Guam, CNMI, PRIA, and NWHI, including, but not limited to, in-water and coastal construction, dredging and disposal, water quality and discharges, fishery management, military activities, shipwreck and marine debris removal, scientific research and monitoring, aquaculture, protected area management, and beach nourishment and shoreline protection (Appendix C). Further, the global oceans are being impacted by climate change from greenhouse gas emissions, particularly the tropical oceans in which the listed corals occur (NMFS 2014, 2021). The impacts from these activities, combined with those from natural factors (e.g., major storm events), significantly affect habitat for all life stages for these threatened corals. We conclude that the essential feature is currently and will likely continue to be negatively impacted by some or all of these factors.

Greenhouse gas emissions (e.g., fossil fuel combustion) lead to global climate change and ocean acidification. These activities adversely affect the essential feature by increasing sea surface temperature and decreasing the aragonite saturation state. Coastal and in-water construction, channel dredging, and beach nourishment activities can directly remove the essential feature by dredging it or by depositing sediments on it, making it unavailable for settlement and recruitment of coral larvae or fragments. These same activities can impact the essential feature by creating turbidity during operations. Stormwater run-off, wastewater and sewage outflow discharges, and point and non-point source pollutant discharges can adversely impact the essential feature by allowing nutrients and sediments from point and non-point sources, including sewage, stormwater and agricultural runoff, river discharge, and groundwater, to alter the natural levels in the water column. The same activities can also adversely affect the essential feature by increasing the growth rates of macroalgae, allowing them to preempt available recruitment habitat. Fishing can adversely affect the essential feature by reducing the number of herbivorous fishes available to control the growth of macroalgae on the substrate.

Based on the above, we determined that the essential feature may require special management considerations or protection generally throughout the species' ranges, because threats to this feature exist within these areas.

3.4. Specific Areas Within the Geographical Areas Occupied by the Species

The definition of critical habitat further instructs us to identify specific areas on which are found the physical or biological feature essential to the species' conservation. Our regulations state that critical habitat will be defined by specific limits using reference points and lines on standard topographic maps of the area, and referencing each area by the State, county, or other local governmental unit in which it is located (50 CFR 424.12(c)). Our regulations also state that when several habitats, each satisfying requirements for designation as critical habitat, are located in proximity to one another, an inclusive area may be designated as critical habitat (50 CFR 424.12(d)).

In section 3.1, we identified marine habitat around 18 U.S. islands that were within the occupied area for at least one of the five listed coral species at the time of their listing in 2014 as well as their depth ranges (Table 2), which are referred to as critical habitat units. In section 3.2, we defined the essential feature of critical habitat for the listed coral species as a composite of specific habitat characteristics, including both suitable substrate (i.e., consolidated hard substrate with crevices and holes but low sediment and algae) and suitable water quality (i.e., appropriate seawater temperature, aragonite saturation state, nutrients, and water clarity/turbidity but low contaminants). In Section 3.3, we determined that the essential feature may require special management considerations or protection. The next step is to delineate specific areas within each unit and depth range where the essential feature is found, which is done in this section.

Comprehensive, detailed substrate information is available throughout the 18 units from PIFSC's comprehensive coral reef monitoring reports (Brainard at al. 2008, 2012, 2019) and substrate maps (PIFSC 2021), the National Centers for Coastal Ocean Sciences' (NCCOS) Benthic Habitat Atlases (NCCOS 2003, 2005, 2010), and the Pacific Islands Benthic Habitat Mapping Center's maps and data (PIBHMC 2021). Substrate characteristics such as geomorphological structure (e.g., spur-and-groove, aggregate reef, etc.) are generally stable for long periods of time, thus older information is likely still accurate. In contrast, water quality information is not widely available throughout the 18 units, and when it is available, it may be quickly outdated. Also, information on listed species distributions and biological cover could potentially be used as surrogates for the essential feature, but they both can fluctuate over short time periods, thus these types of information may also be quickly outdated. Therefore, substrate information was primarily used to delineate the specific areas, although water quality information was also used to refine delineations of the specific areas, as described below.

Specific areas were delineated in four steps: (1) General information was used to delineate soft vs. hard substrates, leaving only hard substrate areas; (2) for the hard substrate areas identified in Step 1, specific substrate information was used to delineate unsuitable vs. suitable hard substrates, leaving only the latter; (3) for the suitable hard substrate areas identified in Step 2, we used water quality information to further delineate suitable vs. unsuitable areas; and (4) from the suitable areas identified in Steps 1-3, we removed any overlapping artificial substrates and managed areas. The four steps were implemented for each of the 18 units as follows:

1. For Step 1, we used comprehensive hard-soft substrate maps developed by PIFSC (PIFSC 2021) to delineate soft vs. hard substrates, leaving only hard substrate areas within the combined depth ranges of all listed species in each unit for 16 of the 18 units. For Wake Atoll, we used the substrate map from PIBHMC (2021). For French Frigate Shoals, we used the geomorphological structure component of the maps developed by NCCOS (2003).
2. For Step 2, we started with the hard substrate areas identified in Step 1, then distinguished unsuitable vs. suitable hard substrates. Many hard substrates are unsuitable because: (1) highly-fluctuating physical conditions cause extreme changes in water quality (e.g., shallow pavement and rubble, especially on reef flats); (2) water motion continuously mobilizes sediment (e.g., pavement with sand channels) or unstable substrate (e.g., rubble); or (3) flat, low-relief areas provide poor settlement and growth habitat (e.g., pavement). Removal of these areas left suitable hard substrates, including spur-and-groove, individual patch reef, aggregate reef, aggregated patch reef, scattered coral/rock, and rock/boulder. For this step, primary information sources were Brainard at al. (2008, 2012, 2019), NCCOS (2003, 2005, 2010), PIBHMC (2021), PIFSC (2021), the detailed public comment letters from the Territories (AS DMWR 2021, CNMI DLNR 2021, Guam DOAG 2021), and the American Samoa, Guam, CNMI, PRIA, and NWHI chapters in Waddell and Clarke (2008). Additional sources for individual units are cited in the unit sections below.
3. For Step 3, starting with the suitable hard substrate areas identified in Step 2, we used water quality information to further delineate suitable vs. unsuitable areas. Some of the areas identified in Step 2 are chronically subject to pollution such as excessive nutrients, excessive sediment, contaminants, or other water quality problems, making them unsuitable. Generally, such areas occur in enclosed lagoons and inner harbors where there is high runoff and limited water circulation. Outside of such areas, point and non-point sources of pollution generally do not overlap with suitable hard substrates because wastewater outfalls are located on soft substrates beyond the reef slopes, and stormwater and freshwater discharge occurs primarily on soft substrates (sand or mud) or unsuitable

hard substrates (pavement or rubble) along or near shorelines. For this step, primary information sources were Brainard at al. (2008, 2012, 2019), EPA (2021a-f), the detailed public comment letters from the Territories (AS DMWR 2021, CNMI DLNR 2021, Guam DOAG 2021), Territory water quality assessments (AS EPA 2020, CNMI BECQ 2018), and sources for individual units cited in the unit sections below.

4. For Step 4, from the suitable areas identified via the above three steps, we removed any artificial substrates and managed areas, because they do not provide the essential feature, as explained in section 3.2.3 above. This only applies to existing artificial substrates and managed areas, not proposed or planned artificial substrates and managed areas.

The resulting specific areas are where we consider the essential feature to currently be distributed within each island unit and depth range, based on the best available information. However, on smaller spatial scales, there are likely locations within the specific areas that lack the essential feature, and the exact locations with and without the essential feature are likely to change somewhat over time in response to changing conditions. Thus, the specific areas described below are intended to delineate areas containing the essential feature, rather than areas made up completely and permanently of the essential feature.

The following subsections describe the application of our four-step process to determine the specific areas containing the essential feature for each of the 18 units. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described later in this report. The unit names and order are based on Table 2 above. In addition, two topics important to all specific areas are addressed at the end of this section: (1) Specific area delineation vs. incremental impacts; and (2) specific areas and climate change impacts.

3.4.1. Tutuila and Offshore Banks

This unit includes the nearshore waters of Tutuila Island, the adjacent small island of Aunu'u Island, and offshore banks. The unit has a land area of 142 km^2 (55 mi^2), more than the other five islands in the Territory combined. Tutuila is a highly eroded, volcanic remnant. Its coral reefs consist mainly of well-developed fringing reefs, typically made up of a backreef (i.e., pools, lagoons, channels, and reef flats of 0 – 2 m depth between the beach and the reef crest) and a forereef (i.e., reef slope) descending to 20 or 30 m of depth where it reaches a broad shelf (Brainard et al. 2008, Waddell and Clarke 2008). The shelf continues for several kilometers and to a depth of 100 – 200 m, with the outer edge consisting of a ring of banks, some of which rise to <50 m of depth (Montgomery et al. 2019, Toonen and Montgomery 2018, Wright et al. 2012). This unit does not include South Bank, a sunken atoll about 60 km south of Tutuila.

Tutuila and Offshore Banks (not including South Bank) is within the occupied area for all five of the listed coral species being considered for proposed critical habitat designation, which have a combined depth range of 0 – 50 m in this unit (Table 2). In the 2020 proposed coral critical habitat rule, this unit included South Bank, which has a minimum depth of approximately 25 m. However, as explained in the Records Document (Appendix A), South Bank does not provide the essential feature of critical habitat for any listed coral species, thus it is not considered further. The specific areas containing the essential feature were identified on Tutuila and its offshore banks via the following four steps, based on the best available information (NCCOS 2005, Brainard et al. 2008, Waddell and Clarke 2008, NOAA CRCP 2009a, Kendall and Poti 2011, NOAA ONMS 2012, Wright et al. 2012, Heenan et al. 2014, McCoy et al. 2016, 2017, Polidoro et al. 2017, McCoy et al. 2018b, Toonen and Montgomery 2018, Mason and Whitall 2019, NOAA CRCP 2018a, Montgomery et al. 2019, AS EPA 2020, AS DMWR 2021, EPA 2021a,b, PIBHMC 2021, and PIFSC 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 50 m of depth using the PIFSC substrate map for Tutuila (PIFSC 2021). Extensive areas of soft substrate occur

within this depth range around Tutuila, including Pala Lagoon, shallows adjacent to sandy or silty beaches and coves, sandy or muddy areas within large bays (e.g., Pago Pago, Vatia, etc.), and extensive sandy areas on the shelf at the bottom of reef slopes.

2. For Step 2, we started with all hard substrates identified in Step 1, then removed those that are unsuitable, including all pavement and rubble. Large proportions of hard substrates within very shallow (e.g., many reef flats) and very deep (e.g., much of the shelf at the bottom of reef slopes) areas are unsuitable, as they consist of pavement and rubble. Removal of these unsuitable areas left only spur-and-groove, individual patch reef, aggregate reef, aggregated patch reef, scattered coral/rock, and rock/boulder, all of which provide potentially suitable hard substrate. The hard substrates were delineated using information provided in NCCOS (2005), Brainard et al. (2008), Kendall and Poti (2011), and AS DMWR (2021). Of these, Kendall and Poti's (2011) Appendix B (Shoreline to shelf edge benthic maps of Tutuila, American Samoa) was the primary source, as it provides detailed benthic geomorphological structure maps from 0 to 90 m depth for this entire unit.
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas. Some of the suitable hard substrate areas identified in Step 2 are chronically subject to high turbidity and contaminants, including the aggregate patch reef within the mouth of Pala Lagoon, the boulder/rock inside Pala Lagoon, and the boulder/rock along inner Pago Pago Harbor (NCCOS 2005, Brainard et al. 2008, Polidoro et al. 2017, Mason and Whitall 2019, and AS EPA 2020). Thus, these areas are not considered for proposed coral critical habitat. Outside of these areas, point and non-point sources of pollution generally do not overlap with suitable hard substrates because Tutuila's wastewater outfalls are located on soft substrates beyond the reef slopes (EPA 2021b), and stormwater and freshwater discharge occurs primarily onto sand, mud, pavement or rubble at stream mouths, beaches, and reef flats (NCCOS 2005, AS EPA 2020, EPA 2021a).
4. For Step 4, from the suitable areas identified via the above three steps, we removed all artificial substrates and managed areas on Tutuila (listed in Appendix B) from consideration for proposed coral critical habitat. These include any suitable hard substrates identified in Step 2 that occur within managed areas. For example, the entrance channels for the Aunu'u and Auasi Small Boat Harbors include some suitable hard substrates, but these and any other such suitable hard substrates within managed areas in this unit were removed from proposed coral critical habitat.

In summary, the suitable areas between 0 and 50 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and maps are provided in Section 6.

3.4.2. **Ofu-Olosega**

Ofu and Olosega Islands are small, twin volcanic islands separated by a gap of only about 75 m with a collective land area of 13 km^2 (5 mi^2) and surrounded by fringing coral reefs. The two islands are connected by a bridge and are treated as a single unit (Ofu-Olosega). This unit is located in the Manu'a Islands, approximately 100 km east of Tutuila Island. Ta'u Island, the third island of the Manu'a group, is located approximately 10 km to the southeast of Ofu-Olosega (Brainard et al. 2008, Waddell and Clarke 2008).

Ofu-Olosega is is within the occupied area for three listed species being considered for proposed critical habitat designation (*A. globiceps, A. retusa,* and *I. crateriformis*), all of which have depth ranges of 0 – 20 m in this unit (Table 2). The specific areas containing the essential feature were identified on Ofu-Olosega via the following four steps, based on the best available information

(NCCOS 2005, Brainard et al. 2008, Waddell and Clarke 2008, NOAA CRCP 2009a, Heenan et al. 2014, McCoy et al. 2016, 2017, McCoy et al. 2018b, NOAA CRCP 2018a, AS DMWR 2021, EPA 2021a,b, PIBHMC 2021, and PIFSC 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 20 m of depth using the PIFSC substrate map for Ofu-Olosega (PIFSC 2021). In this unit, soft substrate areas are limited to a few small sand patches.
2. For Step 2, we started with the hard substrates identified in Step 1, then removed those that are unsuitable, including all pavement and rubble. Pavement includes many reef flats as well as some deeper areas. Removal of these unsuitable areas left only spur-and-groove, individual patch reef, aggregate reef, aggregated patch reef, scattered coral/rock, and rock/boulder, all of which provide potentially suitable hard substrate. The hard substrates were delineated using information provided in NCCOS (2005), Brainard et al. (2008), and AS DMWR (2021).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Brainard et al. 2008, Heenan et al. 2014, McCoy et al. 2016, 2017, 2018b, AS EPA 2020, EPA 2021a,b,). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. For Step 4, from the suitable areas identified via the above three steps, we removed all artificial substrates and managed areas on Ofu-Olosega (listed in Appendix B) from consideration for proposed coral critical habitat. In this unit, the only major managed area is Ofu Small Boat Harbor and its entrance channel, but it contains no suitable hard substrates.

In summary, the suitable areas between 0 and 20 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and maps are provided in Section 6.

3.4.3. **Ta'u**

Ta'u Island is the easternmost member of the Manu'a Island group, with a land area of 45 km^2 (17 mi^2). Intermediate in size between Tutuila and Ofu-Olosega, Ta'u is also volcanic, but younger and less eroded. Fringing reefs are most developed along the northwest and southeast coasts, but limited or absent elsewhere (Brainard et al. 2008, Waddell and Clarke 2008).

Ta'u is within the within the occupied area for two listed species being considered for proposed critical habitat designation (*A. globiceps* and *I. crateriformis*), which have a combined depth range of 0 – 20 m (Table 2). The specific areas containing the essential feature were identified on Ta'u via the following four steps, based on the best available information (NPSA 1997, NCCOS 2005, Brainard et al. 2008, Waddell and Clarke 2008, NOAA CRCP 2009a, Heenan et al. 2014, McCoy et al. 2016, 2017, 2018b, NOAA CRCP 2018a, AS EPA 2020, AS DMWR 2021, EPA 2021a,b, PIBHMC 2021, PIFSC 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 20 m of depth using the PIFSC substrate map for Ta'u (PIFSC 2021). However, in this unit, there are very few soft substrate areas at these depths.
2. For Step 2, we started with the hard substrates identified in Step 1, then removed those that are unsuitable, including all pavement and rubble. Pavement includes many reef flats as well as some deeper areas. Removal of these unsuitable areas left only spur-and-groove, individual patch reef, aggregate reef, aggregated patch reef, scattered coral/rock, and rock/boulder, all of which provide potentially suitable hard substrate. The hard substrates

were delineated using information provided in NCCOS (2005), Brainard et al. (2008), and AS DMWR (2021).

3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Brainard et al. 2008, Heenan et al. 2014, McCoy et al. 2016, 2017, 2018b, AS EPA 2020, EPA 2021a,b). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. For Step 4, from the suitable areas identified via the above three steps, we removed all artificial substrates and managed areas on Ta'u (listed in Appendix B) from consideration for proposed coral critical habitat. These include any suitable hard substrates identified in Step 2 that occur within managed areas. For example, the entrance channels to Ta'u and Faleasao Harbors include some suitable hard substrates, but these and any other such suitable hard substrates within managed areas in this unit were removed from proposed coral critical habitat.

In summary, the suitable areas between 0 and 20 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and maps are provided in Section 6.

3.4.4. **Rose Atoll**

The uninhabited Rose Atoll is located at the far eastern end of the Samoan Archipelago, approximately 300 km east of Tutuila Island. In contrast to the high, volcanic islands of Tutuila and the Manu'a group, Rose is a typical atoll consisting of a barrier reef enclosing a lagoon, and a very small emergent land area (<1 km^2). The forereef around the outside of the atoll drops steeply into deep water (to at least 3,000 m), while the nearly enclosed lagoon consists of a shallow shelf composed of patch reefs interspersed with a rubble flat, and a sandy lagoon floor with scattered pinnacles rising up to near the surface (Brainard et al. 2008, Waddell and Clarke 2008, USFWS 2014). The atoll, its lagoon, and surrounding waters are included in the Rose Atoll National Marine Monument, which is managed by USFWS and described in its Comprehensive Conservation Plan (USFWS 2014).

Rose Atoll is an occupied area for two of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps* and *A. retusa*), within a combined depth range of 0 – 20 m (Table 2). The specific areas containing the essential feature were identified on Rose Atoll via the following four steps, based on the best available information (NCCOS 2005, Brainard et al. 2008, Waddell and Clarke 2008, NOAA CRCP 2009a, Heenan et al. 2014, USFWS 2014, McCoy et al. 2016, 2017, 2018b, NOAA CRCP 2018a, PIBHMC 2021, PIFSC 2021, USFWS 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 20 m of depth using the PIFSC substrate map for Rose Atoll (PIFSC 2021), and the benthic map provided in USFWS (2014). The soft substrates within this depth range are primarily within the central portion of the lagoon.
2. For Step 2, we started with the hard substrates identified in Step 1, then removed those that are unsuitable, including all pavement and rubble. Pavement includes many reef flats as well as some deeper areas. Removal of these unsuitable areas left only spur-and-groove, aggregate reef, aggregated patch reef, and scattered coral/rock, all of which provide potentially suitable hard substrate. The hard substrates were delineated using information provided in NCCOS (2005), Brainard et al. (2008), and USFWS (2014).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Brainard et al. 2008, Heenan et al. 2014, USFWS 2014, McCoy et al. 2016,

2017, 2018b). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. Step 4 was not necessary for this unit because there are no artificial substrates or managed areas on Rose Atoll (Appendix B).

In summary, the suitable areas between 0 and 20 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and maps are provided in Section 6.

3.4.5. Guam

This unit includes the nearshore waters of Guam, the largest island in Micronesia. Guam has a land area of 544 km^2 (210 mi^2) and a shoreline 244 km long, and is located at the southern end of the Mariana Archipelago. Apra Harbor on the central west coast of Guam is one of the largest harbors in the western Pacific. The geology of Guam is unique in the Mariana Archipelago because the northern half is uplifted limestone but the southern half is of volcanic origin and highly susceptible to erosion (Brainard et al. 2012). Most of Guam's coral reefs are fringing reefs, which extend around much of the island, but there are also patch reefs, a barrier reef on the south side of the island, and offshore banks (Waddell and Clarke 2008).

Guam is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 12 m (Table 2). In the 2020 coral critical habitat rule, this unit included three offshore banks: Santa Rosa Reef (46 km to the southwest with a minimum depth of 8 m), Galvez Bank (22 km to the southwest with a minimum depth of 25 m), and 11-mile Reef (17 km to the west with a minimum depth of 20 m). However, as explained in the Records Document (Appendix A), neither *A. globiceps* or any other listed coral is likely to occur on any of the offshore banks, thus they are not considered further. The specific areas containing the essential feature were identified on Guam via the following four steps, based on the best available information (Burdick 2005, NCCOS 2005, Waddell and Clarke 2008, NOAA CRCP 2009b, USFWS 2009, Brainard et al. 2012, Heenan et al. 2015, Maynard et al. 2017, McCoy et al. 2018a, NOAA CRCP 2018b, Raymundo et al. 2018, DON 2019a, Nelson et al. 2019, EPA 2021c,d, Guam DOAG 2021, PIBHMC 2021, PIFSC 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 12 m of depth using the PIFSC substrate map for Guam (PIFSC 2021). Extensive areas of soft substrate occur within this depth range around Guam, including the shallows adjacent to sandy or muddy beaches and coves, large sand patches and banks, and other areas.
2. For Step 2, we started with the hard substrates identified in Step 1, then removed those that are unsuitable, including all pavement and rubble. Pavement includes many reef flats as well as some deeper areas. Removal of these unsuitable areas left only spur-and-groove, individual patch reef, aggregate reef, aggregated patch reef, scattered coral/rock, and rock/boulder, all of which provide potentially suitable hard substrate. The hard substrates were delineated using information provided in Burdick (2005), NCCOS (2005), Brainard et al. (2012), Raymundo et al. (2018), DON (2019a), and Guam DOAG (2021).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Heenan et al. 2015, McCoy et al. 2018a, DON 2019a, Nelson et al. 2019, EPA 2021c,d, Guam DOAG 2021). Some of the suitable hard substrate areas identified in Step 2 are chronically subject to high turbidity and contaminants, such as the individual patch reef, aggregate reef, and scattered rock/coral within inner Apra Harbor (NCCOS 2005, DON 2019a, Nelson et al. 2019). Thus, these areas are not considered for proposed coral

critical habitat. Outside of these areas, point and non-point sources of pollution generally do not overlap with suitable hard substrates because Guam's wastewater outfalls are located on soft substrates beyond the reef slopes (EPA 2021d), and stormwater and freshwater discharge occurs primarily onto sand, mud, pavement or rubble at stream mouths, beaches, and reef flats (NCCOS 2005, EPA 2021c).

4. For Step 4, from the suitable areas identified via the above three steps, we removed all artificial substrates and managed areas on Guam (listed in Appendix B) from consideration for proposed coral critical habitat. These include any suitable hard substrates identified in Step 2 that occur within managed areas. For example, the entrance channel to Agat Harbor includes some suitable hard substrates, but these and any other such suitable hard substrates within managed areas in this unit were removed from proposed coral critical habitat.

In summary, the suitable areas between 0 and 12 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.6. **Rota**

Rota is the southernmost of CNMI's 14 islands, with a land area of 85 km^2 (33 mi^2). Rota, like the neighboring islands of Guam, Aguijan, Tinian, and Saipan, is composed of a series of coralline limestone terraces that lie on top of a volcanic core. Most of Rota's coastline is surrounded by fringing reefs with narrow reef flats, and limestone cliffs and benches that drop abruptly into the sea (Waddell and Clarke 2008, Brainard et al. 2012).

Rota is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 12 m (Table 2). The specific areas containing the essential feature were identified on Rota via the following four steps, based on the best available information (NCCOS 2005, Waddell and Clarke 2008, Brainard et al. 2012, Heenan et al. 2015, CNMI BECQ 2018, McCoy et al. 2018a, NOAA CRCP 2018c, CNMI DLNR 2021, EPA 2021e,f, PIBHMC 2021, PIFSC 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 12 m of depth using the PIFSC substrate map for Rota (PIFSC 2021). In this unit, soft substrate areas consist of scattered sand patches.
2. For Step 2, we started with the hard substrates identified in Step 1, then removed those that are unsuitable, including all pavement and rubble. Pavement includes many reef flats as well as some deeper areas. Removal of these unsuitable areas left only spur-and-groove, aggregate reef, aggregated patch reef, and rock/boulder, all of which provide potentially suitable hard substrate. The hard substrates were delineated using information provided in NCCOS (2005), Brainard et al. (2012), and CNMI DLNR (2021).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Brainard et al. 2012, Heenan et al. 2015, CNMI BECQ 2018, McCoy et al. 2018a, CNMI DLNR 2021, EPA 2021e,f,). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. For Step 4, from the suitable areas identified via the above three steps, we removed all artificial substrates and managed areas on Rota (listed in Appendix B) from consideration for proposed coral critical habitat. These include any suitable hard substrates identified in Step 2 that occur within managed areas. For example, the entrance channel to Rota West Harbor includes some suitable hard substrate, but this and any other such suitable hard

substrates within managed areas in this unit were removed from proposed coral critical habitat.

In summary, the suitable areas between 0 and 12 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.7. Aguijan

The uninhabited Aguijan Island is located just south of Tinian, and has a land area of 7 km^2 (2.7 mi2). Aguijan's coastline consists entirely of limestone cliffs and benches that drop abruptly into the sea. An extensive shallow area of hard substrate occurs to the southwest of the island (Brainard et al. 2012, Waddell and Clarke 2008).

Aguijan is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 12 m (Table 2). The specific areas containing the essential feature were identified on Aguijan via the following four steps, based on the best available information (NCCOS 2005, Waddell and Clarke 2008, Brainard et al. 2012, Heenan et al. 2015, McCoy et al. 2018a, NOAA CRCP 2018c, CNMI DLNR 2021, PIBHMC 2021, PIFSC 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 12 m of depth using the PIFSC substrate map for Aguijan (PIFSC 2021). In this unit, soft substrate areas are limited to a few small sand patches.
2. For Step 2, we started with the hard substrates identified in Step 1, then removed those that are unsuitable. In this unit, unsuitable hard substrates are made up entirely of pavement. Removal of these unsuitable areas left only spur-and-groove and aggregated patch reef. The hard substrates were delineated using information provided in NCCOS (2005), Brainard et al. (2012), and CNMI DLNR (2021).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Brainard et al. 2012, Heenan et al. 2015, McCoy et al. 2018a, CNMI DLNR 2021). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. Step 4 was not necessary for this unit because there are no artificial substrates or managed areas on Aguijan (Appendix B).

In summary, the suitable areas between 0 and 12 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.8. Tinian

Tinian is the third largest of CNMI's 14 islands, with a land area of 101 km^2 (39 mi^2). Tinian's coastline includes some fringing reefs with narrow reef flats but is mostly made up of limestone cliffs and benches that drop abruptly into the sea. Tatsumi Reef lies approximately 2 km to the southeast of Tinian with a minimum depth of 6 m (Waddell and Clarke 2008, Brainard et al. 2012).

Tinian is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 12 m (Table 2). In the 2020 proposed coral critical habitat rule, this unit included Tatsumi Reef. However, as noted in the

Records Document (Appendix A), Tatsumi Reef does not provide the essential feature of critical habitat for any listed coral species, thus it is not considered further. The specific areas containing the essential feature were identified on Tinian via the following four steps, based on the best available information (NCCOS 2005, Waddell and Clarke 2008, Brainard et al. 2012, Tetra Tech 2014, Heenan et al. 2015, Maynard et al. 2015, CNMI BECQ 2018, Maynard et al. 2018, McCoy et al. 2018a, NOAA CRCP 2018c, DON 2019a, CNMI DLNR 2021, EPA 2021e,f, PIBHMC 2021, PIFSC 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 12 m of depth using the PIFSC substrate map for Tinian (PIFSC 2021). In this unit, soft substrate areas consist of scattered sand patches.
2. For Step 2, we started with the hard substrates identified in Step 1, then removed those that are unsuitable, including all pavement and rubble. Pavement includes many reef flats as well as some deeper areas. Removal of these unsuitable areas left only spur-and-groove, aggregate reef, and aggregated patch reef. The hard substrates were delineated using information provided in NCCOS (2005), Brainard et al. (2012), Tetra Tech (2014), DON (2019a), and CNMI DLNR (2021).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Brainard et al. 2012, Tetra Tech 2014, Heenan et al. 2015, CNMI BECQ 2018, McCoy et al. 2018a, DON 2019a, CNMI DLNR 2021, EPA 2021e,f). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. For Step 4, from the suitable areas identified via the above three steps, we removed all artificial substrates and managed areas on Tinian (listed in Appendix B) from consideration for proposed coral critical habitat. These include any suitable hard substrates identified in Step 2 that occur within managed areas. For example, the entrance channel to Tinian Harbor includes some suitable hard substrate, but this and any other such suitable hard substrates within managed areas in this unit were removed from proposed coral critical habitat.

In summary, the suitable areas between 0 and 12 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.9. **Saipan**

Saipan is the second-largest island in the Mariana archipelago (after Guam), has a land area of 119 km^2 (46 mi^2), and a shoreline 75 km long. The island has the most diverse types of coral reefs and associated habitats in CNMI, including a barrier reef enclosing a lagoon along most of the west side of the island, fringing reefs around much of the remainder of the island, patch reefs, and a large offshore bank (Waddell and Clarke 2008, Brainard et al. 2012).

Saipan is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 12 m (Table 2). In the 2020 proposed coral critical habitat rule, this unit included the large offshore Garapan Bank west of Saipan. However, as explained in the Records Document (Appendix A), there are no records of *A. globiceps* from Garapan Bank, and its shallowest point (≈20 m) is deeper than the depth range of *A. globiceps* in the Mariana Islands (0 – 12 m), thus Garapan Bank is not considered from this point forward. The specific areas containing the essential feature were identified on Saipan via the following four steps, based on the best available information (NCCOS 2005, Houk and van Woesik 2008, Waddell and Clarke 2008, NOAA CRCP 2009c, Brainard et al. 2012, Heenan et al. 2015, Maynard et al. 2015, CNMI BECQ 2018, Maynard et al. 2018, McCoy et al. 2018a, NOAA CRCP 2018c, CNMI DLNR 2021, EPA 2021e,f, PIBHMC 2021, PIFSC 2021).

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 12 m of depth using the PIFSC substrate map for Saipan (PIFSC 2021). Extensive areas of soft substrate occur within this depth range around Saipan, including much of the substrate of Saipan Lagoon, and other sand patches of various sizes.
2. For Step 2, we started with the hard substrates identified in Step 1, then removed those that are unsuitable, including all pavement and rubble. Pavement includes many reef flats as well as some deeper areas. Removal of these unsuitable areas left only spur-and-groove, individual patch reef, aggregate reef, aggregated patch reef, scattered coral/rock, and rock/boulder, all of which provide potentially suitable hard substrate. The hard substrates were delineated using information provided in NCCOS (2005), Brainard et al. (2012), and CNMI (DLNR 2021).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Houk and van Woesik 2008, Brainard et al. 2012, Heenan et al. 2015, CNMI BECQ 2018, McCoy et al. 2018a, EPA 2021e,f). Some of the suitable hard substrate areas identified in Step 2 are chronically subject to high turbidity and contaminants, such as the aggregated patch reef and scattered rock/coral within and near the Puerto Rico Industrial Area marine waters (CNMI BECQ 2018, CNMI DLNR 2021). Thus, these areas are not considered for proposed coral critical habitat. Outside of these areas, point and non-point sources of pollution generally do not overlap with suitable hard substrates because Saipan's wastewater outfalls are located on soft substrates that are not in close proximity to suitable hard substrates (CNMI BECQ 2018, EPA 2021f), and stormwater and freshwater discharge occurs primarily onto sand, pavement or rubble at stream mouths, beaches, and reef flats (NCCOS 2005, EPA 2021e).
4. For Step 4, from the suitable areas identified via the above three steps, we removed all artificial substrates and managed areas on Saipan (listed in Appendix B) from consideration for proposed coral critical habitat. These include any suitable hard substrates identified in Step 2 that occur within managed areas. For example, a portion of the outer navigation channel to Tanapag Harbor includes some suitable hard substrates, but these and any other such suitable hard substrates within managed areas in this unit were removed from proposed coral critical habitat.

In summary, the suitable areas between 0 and 12 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.10. **Farallon de Medinilla**

Farallon de Medinilla (FDM) is an uninhabited island approximately 80 km north of Saipan controlled by the Department of the Navy (DON). The island is 2 km long and 0.5 km wide, but only 20 m wide where the northern and southern parts join. FDM has been used by the Navy as a live and inert firing range since 1971. The island is surrounded by cliffs, and its nearshore waters consist almost entirely of rock and boulder hard substrates (DON 2019a, Waddell and Clarke 2008).

FDM is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 12 m (Table 2). The specific areas containing the essential feature were identified on FDM via the following four steps, based on the best available information (NCCOS 2005, Waddell and Clarke 2008, Smith and Marx 2016, Carilli et al. 2018, NOAA CRCP 2018c, DON 2019a, PIBHMC 2021, PIFSC 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 12 m of depth using the PIFSC substrate map for FDM (PIFSC 2021). In this unit, soft substrate areas are limited to a few small sand patches.
2. For Step 2, we started with the hard substrates identified in Step 1, then removed those that are unsuitable. In this unit, unsuitable hard substrates are made up entirely of pavement. Removal of these unsuitable areas left aggregate reef and rock/boulder. The hard substrates were delineated using information provided in NCCOS (2005) and DON (2019a).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (DON 2019a). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. Step 4 was not necessary for this unit because there are no artificial substrates or managed areas on FDM.

In summary, the suitable areas between 0 and 12 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table is provided in Section 6.

3.4.11. Alamagan

Alamagan Island is located approximately 228 km north of Saipan, has a land area of 12 km^2 (5 mi^2), and is dominated by an active volcano. Alamagan is 4 km wide and 5 km long, with shorelines made up mostly of lava slopes dropping abruptly into the sea interspersed with a few rocky beaches (Brainard et al. 2012).

Alamagan is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 12 m (Table 2). The specific areas containing the essential feature were identified on Alamagan via the following four steps, based on the best available information (NCCOS 2005, Waddell and Clarke 2008, Brainard et al. 2012, Heenan et al. 2015, McCoy et al. 2018a, NOAA CRCP 2018c, PIBHMC 2021):

1. For Step 1, we reviewed the available Alamagan substrate maps (NCCOS 2005, Brainard et al. 2012), which are for approximately 0 to 20 m of depth. Since the depth range of *A. globiceps* on Alamagan is 0 – 12 m (Table 2), all areas from 13 to 20 m were eliminated from consideration before moving on to Step 2. In this unit, soft substrate areas are limited to a few small sand patches.
2. For Step 2, we started with the hard substrates identified in Step 1, then would have removed those that are unsuitable. However, in this unit, hard substrates are made up entirely of rock/boulder, which is a suitable substrate. The hard substrates were delineated using information provided in NCCOS (2005) and Brainard et al. (2012).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Brainard et al. 2012). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. Step 4 was not necessary for this unit because there are no artificial substrates or managed areas on Alamagan (Appendix B).

In summary, the suitable areas between 0 and 12 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.12. Pagan

Pagan Island is located approximately 280 km north of Saipan, has a land area of 48 km^2 (19 mi^2), and the north part of the island is dominated by an active volcano. Two volcanoes formed this island, and a low-lying, narrow isthmus connects them. Pagan is approximately 17 km long, and seven km across at its widest point. Pagan's coastline includes a few lava sand beaches, but consists mostly of lava coastline with some fringing reefs and narrow reef flats (Brainard et al. 2012, Tetra Tech 2014).

Pagan is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 12 m (Table 2). The specific areas containing the essential feature were identified on Pagan via the following four steps, based on the best available information (NCCOS 2005, Brainard et al. 2012, Waddell and Clarke 2008, Schils 2012, Tetra Tech 2014, Heenan et al. 2015, McCoy et al. 2018a, NOAA CRCP 2018c, CNMI DLNR 2021, PIBHMC 2021, PIFSC 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 12 m of depth using the PIFSC substrate map for Pagan (PIFSC 2021). In this unit, there are several extensive sand patches off of beaches.
2. For Step 2, we started with the hard substrates identified in Step 1, then would have removed those that are unsuitable. However, in this unit, hard substrates are made up entirely of rock/boulder, which is a suitable substrate. The hard substrates were delineated using information provided in NCCOS (2005), Brainard et al. (2012), and DON (2019a).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Brainard et al. 2012, Schils 2012, DON 2019a). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. Step 4 was not necessary for this unit because there are no artificial substrates or managed areas on Pagan (Appendix B).

In summary, the suitable areas between 0 and 12 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.13. Maug Islands

The Maug Islands are located approximately 500 km north of Saipan and include three remnants of an eroded outer rim of a caldera approximately 2 km in diameter, with a land area of 2 km^2 (0.8 mi^2). All three islands are very steep, and their shorelines are made up entirely of lava cliffs and slopes dropping abruptly into the sea (Waddell and Clarke 2008, Brainard et al. 2012, NOAA-USFWS-CNMI 2020).

Maug is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 12 m (Table 2). In the 2020 proposed coral critical habitat rule, this unit included Supply Reef approximately 25 km to the north of the Maug Islands. However, as explained in the Records Document (Appendix A), there are no records of *A. globiceps* or any other listed coral species from Supply Reef, thus it is not considered from this point forward. The specific areas containing the essential feature were identified on Maug via the following four steps, based on the best available information (NCCOS

2005, Waddell and Clarke 2008, Brainard et al. 2012, Heenan et al. 2015, McCoy et al. 2018a, NOAA CRCP 2018c, CNMI DLNR 2021, PIBHMC 2021, PIFSC 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 12 m of depth using the PIFSC substrate map for Maug (PIFSC 2021). However, virtually this entire unit is hard substrate.
2. For Step 2, we started with the hard substrates identified in Step 1, then would have removed those that are unsuitable. However, in this unit, hard substrates are made up entirely of rock/boulder, which is a suitable substrate. The hard substrates were delineated using information provided in NCCOS (2005) and Brainard et al. (2012).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (NCCOS 2005, Brainard et al. 2012, Heenan et al. 2015, McCoy et al. 2018a, NOAA CRCP 2018c). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. Step 4 was not necessary for this unit because there are no artificial substrates or managed areas on Maug (Appendix B).

In summary, the suitable areas between 0 and 12 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.14. **Uracas (Farallon de Pajaros)**

Uracas (also known as Farallon de Pajaros) is the northernmost CNMI island, at approximately 590 km north of Saipan with a land area of 2.3 km^2 (<1 mi^2), and is dominated by an active volcano. Uracas is approximately 1.6 km wide and 1.8 km long, with shorelines made up mostly of precipitous cliffs and steep slopes of unstable rubble (Brainard et al. 2012).

Uracas is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 12 m (Table 2). The specific areas containing the essential feature were identified on Uracas via the following four steps, based on the best available information (NCCOS 2005, Waddell and Clarke 2008, Brainard et al. 2012, Heenan et al. 2015, McCoy et al. 2018a, NOAA CRCP 2018c, PIBHMC 2021):

1. For Step 1, we reviewed the available Uracas substrate maps (NCCOS 2005, Brainard et al. 2012), which are for approximately 0 to 20 m of depth. Since the depth range of *A. globiceps* on Uracas is 0 – 12 m (Table 2), all areas from 13 to 20 m were eliminated from consideration before moving on to Step 2. Most substrates within 0 – 12 m are unconsolidated hard substrates consisting of steep boulder and rubble slopes (NCCOS 2005, Brainard et al. 2012).
2. For Step 2, we started with the hard substrates identified in Step 1, then would have removed those that are unsuitable. However, in this unit, hard substrates are made up entirely of rock/boulder, which is a suitable substrate. The hard substrates were delineated using information provided in NCCOS (2005) and Brainard et al. (2012).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Brainard et al. 2012). While the extensive volcanic activity of Uracas affects water quality on the north side of the island (Brainard et al. 2012), coral reef monitoring surveys done in 2014 indicate suitable substrate on around the rest of the island (Appendix A). That is, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.

4. Step 4 was not necessary for this unit because there are no artificial substrates or managed areas on Uracas (Appendix B).

In summary, the suitable areas between 0 and 12 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.15. **Palmyra Atoll**

Palmyra Atoll, located 5 degrees north of the equator, is an exposed seamount summit within the Line Islands volcanic chain of the central Pacific, lying about 1,800 km southwest of Honolulu. The atoll is made up of several islands with about 14 km of shoreline that encircle multiple lagoons. During Department of Defense (DOD) control of the atoll during the World War II era, a variety of modifications were made, including extensive dredging and construction. Palmyra's coral reefs consist of an extensive complex of reef flats, patch reefs, terraces, barrier reefs, and reef slopes that together provide approximately 60 km^2 of shallow and deep coral reef habitat (Waddell and Clarke 2008, NCCOS 2010, Brainard et al. 2019).

Palmyra is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 10 m (Table 2). The specific areas containing the essential feature were identified on Palmyra via the following four steps, based on the best available information (Waddell and Clarke 2008, NCCOS 2010, Heenan et al. 2014, McCoy et al. 2016, 2018b, Brainard et al. 2019, PIBHMC 2021, PIFSC 2021, USFWS 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 10 m of depth using the PIFSC substrate map for Palmyra (PIFSC 2021). There are extensive soft substrates within the lagoon.
2. For Step 2, we started with the hard substrates identified in Step 1, then removed those that are unsuitable, including all pavement and rubble. Pavement includes many reef flats as well as some deeper areas. Removal of these unsuitable areas left only spur-and-groove, individual patch reef, aggregate reef, aggregated patch reef, and sand with scattered coral and rock, all of which provide potentially suitable hard substrate. The hard substrates were delineated using information provided in NCCOS (2010).
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Heenan et al. 2014, McCoy et al. 2016, 2018b, Brainard et al. 2019, USFWS 2021). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. For Step 4, we removed any artificial substrates and managed areas remaining within the areas considered for coral critical habitat. All artificial substrates and managed areas on Palmyra are listed in Appendix B (whether within the areas considered for coral critical habitat or not), all of which are removed from further consideration for coral critical habitat in this unit.

In summary, the suitable areas between 0 and 10 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.16. **Johnston Atoll**

Johnston Atoll is a coral atoll consisting of several small islands and is located about 1,400 km southwest of Honolulu. During 70 years of DOD control of the atoll, a variety of modifications were made, including extensive dredging and construction, resulting in the land portion of the atoll increasing by approximately ten-fold. Currently, the atoll is made up of four mostly artificial islands (Johnston, Sand, Akau, Hikina) and a barrier reef on the atoll's northwest side. Johnston's coral reefs consist of a complex of patch reefs, the barrier reef, and reef slopes (Waddell and Clarke 2008, Brainard et al. 2019).

Johnston is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 10 m (Table 2). The specific areas containing the essential feature were identified on Johnston via the following four steps, based on the best available information (Waddell and Clarke 2008, Heenan et al. 2014, McCoy et al. 2016, Brainard et al. 2019, PIBHMC 2021, PIFSC 2021, USFWS 2021):

1. For Step 1, we distinguished soft vs. hard substrates from 0 to 10 m of depth using the PIFSC substrate map for Johnston (PIFSC 2021). There are extensive soft substrates within the lagoon.
2. For Step 2, we started with the hard substrates identified in Step 1, then attempted to remove those that are unsuitable. However, the substrate information for Johnston (Brainard et al. 2019, PIBHMC 2021) is inadequate to distinguish suitable from unsuitable substrates, thus all hard substrates identified in Step 1 were assumed to be suitable.
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Heenan et al. 2014, McCoy et al. 2016, Brainard et al. 2019, USFWS 2021). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. For Step 4, we removed all artificial substrates and some managed areas remaining within the areas considered for coral critical habitat. All artificial substrates and managed areas on Johnston are listed in Appendix B (whether within the areas considered for coral critical habitat or not). The main island (Johnston) is encircled by the Main Channel, the Turning Basin, and the West Channel. In addition, there are several secondary dredged channels and areas (NOAA Chart 83637). However, aside from the Main Channel, the Turning Basin, and the West Channel, no other dredged channels or areas are considered managed areas because they have not received any sort of management activity in decades and have been left for marine life to recolonize over time (USFWS 2021). Thus, all artificial substrates, the Main Channel, the Turning Basin, and the West Channel (but no other dredged channels or areas shown on NOAA Chart 83637) were removed from further consideration for coral critical habitat in this unit.

In summary, the suitable areas between 0 and 10 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.17. **Wake Atoll**

Wake Atoll is a small coral atoll in the central Pacific Ocean between the Hawaiian and the Mariana Islands. The atoll has a total land area of approximately 7.1 km^2 (2.7 mi^2), consisting of three islands (Peale, Wake, and Wilkes Islands) that together with a barrier reef on the northwestern side of the atoll enclose a shallow, central lagoon. During 80 years of military control (U.S. and Japanese) of the atoll, a variety of modifications were made, including air strip installation, harbor dredging, and facility construction. The atoll is an active Air Force base, which at once had a population of over 2,000 people, but now is approximately 100 people (Brainard et al. 2019, USAF 2023A). Wake's coral reefs consist of the barrier reef on the northwestern side of the atoll, extensive and complex reef flats around the northern and eastern sides, and reef slopes around the entire atoll. The lagoon is completely enclosed, has a maximum depth of approximately 5 m, includes little hard substrate, and supports few corals (Waddell and Clarke 2008, Foster et al. 2017, USAF 2023A, Brainard et al. 2019).

Wake is an occupied area for two of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps* and *A. retusa*), within a combined depth range of 0 – 20 m (Table 2), on the reef slope and backreef pools. The specific areas containing the essential feature were identified on Wake via the following four steps, based on the best available information (Waddell and Clarke 2008, Heenan et al. 2015, USAF 2023A, McCoy et al. 2018a, Brainard et al. 2019, PIBHMC 2021, USFWS 2021):

1. For Step 1, we identified all hard substrates from 0 to 20 m of depth (i.e., potential essential feature areas) with the PIBHMC substrate map for Wake (PIBHMC 2021). Since the depth range of the listed species on Wake is 0 – 20 m (Table 2), all areas on the PIBHMC substrate map from 21 to 50 m were eliminated from consideration before moving on to Step 2. The soft substrates within this depth range are almost entirely within the lagoon.
2. For Step 2, we started with all hard substrates identified in Step 1, then would have removed those that are unsuitable. However, the substrate information for Wake (USAF 2023A, Brainard et al. 2019, PIBHMC 2021) is inadequate to distinguish suitable from unsuitable substrates, thus all hard substrates identified in Step 1 were assumed to be suitable.
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas. The suitable hard substrate identified in Step 2 within the lagoon are chronically subject to poor water quality (USAF 2023A, Brainard et al. 2019). Thus, these areas are not considered for proposed coral critical habitat.
4. For Step 4, we removed any artificial substrates and managed areas remaining within the areas considered for coral critical habitat.

In summary, the suitable areas between 0 and 20 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table is provided in Section 6.

3.4.18. **French Frigate Shoals**

French Frigate Shoals (FFS) is a large, eroded atoll in the NWHI, consisting of a 50 km long crescent-shaped barrier reef on its eastern side partially enclosing a large lagoon with several small islets, the largest of which is Tern Island. The eastern half of the lagoon is protected by the barrier reef and is <1 to ≈10 m in depth, while the western half is open to the ocean and shelves gradually to 100 m in depth, then steeply to >1,000 m. FFS's coral reefs consist of an extensive complex of reef slopes, reticulate reefs (i.e., interconnected linear reefs), and patch reefs that together provide hundreds of square km of coral habitat. Tern Island was enlarged by dredging and filling to build a military airfield in the 1940s, which was used for several decades by the U.S. Coast Guard and USFWS (Maragos and Gulko 2002, NOAA-USFWS-HI 2008, Friedlander et al. 2009).

FFS is an occupied area for one of the four listed coral species being considered for proposed critical habitat designation (*A. globiceps*) within a depth range of 0 – 10 m (Table 2). Unlike the other 15 units being considered for proposed coral critical habitat, PIFSC (2021) does not have a substrate map for FFS. However, detailed benthic habitat maps of FFS are provided in NCCOS (2003), and summarized in Friedlander et al. (2009) and PIBHMC (2021). The specific areas containing the essential feature were identified on FFS via the following four steps, based on the best available information (NCCOS 2003, NOAA-USFWS-HI 2008, Waddell and Clarke 2008, Friedlander et al. 2009, Heenan et al. 2015, McCoy et al. 2016, 2017, 2018a, PIBHMC 2021, PIFSC 2021):

1. For Step 1, we reviewed the available FFS substrate maps (NCCOS 2003, Friedlander et al. 2009, PIBHMC 2021), which are for 0 to 20 m of depth. Since the depth range of *A. globiceps* on FFS is 0 – 10 m (Table 2), all areas from 11 to 20 m were eliminated from consideration before moving on to Step 2.
2. For Step 2, we started with all hard substrates identified in Step 1, then would have removed those that are unsuitable. However, the substrate information for FFS (NCCOS 2003, Friedlander et al. 2009, PIBHMC 2021) is inadequate to distinguish suitable from unsuitable substrates, thus all hard substrates identified in Step 1 were assumed to be suitable.
3. For Step 3, we reviewed water quality information to further delineate suitable vs. unsuitable areas (Maragos and Gulko 2002, NOAA-USFWS-HI 2008, Friedlander et al. 2009). However, none of the available information indicated that any of the areas identified in Step 2 are unsuitable.
4. For Step 4, we removed any artificial substrates and managed areas remaining on FFS considered for coral critical habitat. In this unit, artificial substrates are mainly the seawall at Tern Island, and there are no managed areas (Appendix B).

In summary, the suitable areas between 0 and 10 m of depth, as defined in Steps 1 through 4 above, encompass the essential feature for the listed corals found in this unit, and thus are considered for proposed coral critical habitat. These specific areas are subject to the 4(a)(3) and 4(b)(2) analyses described in Sections 4 and 5 of this report, and a summary table and map are provided in Section 6.

3.4.19. **Specific Area Delineation vs. Incremental Impacts**

The primary impacts of a critical habitat designation result from the ESA section 7(a)(2) requirement that Federal agencies ensure that their actions are not likely to result in the destruction or adverse modification of critical habitat, and that they consult with NMFS in fulfilling this requirement. Determining these impacts is complicated by the fact that section 7(a)(2) also requires that Federal agencies ensure their actions are not likely to jeopardize the species' continued existence, because the listing of corals under the ESA in 2014 already requires federal agencies to avoid jeopardizing the listed species. Thus, the impacts of coral critical habitat are only those that would be in addition to the impacts of listing – these additional impacts of critical habitat are referred to as "incremental impacts".

The distribution of listed corals within critical habitat is the main factor that determines the extent of incremental impacts: The more coral critical habitat without colonies of listed corals, the higher the proportion of federal actions that would affect critical habitat but not listed corals (i.e., the higher the number of new consultations required by the designation of critical habitat), and thus the higher the incremental impacts of critical habitat. Conversely, if colonies of listed corals were distributed throughout all specific areas of coral critical habitat, there would be a lower proportion of federal actions that would affect critical habitat but not listed corals, and thus the lower the incremental impacts of critical habitat. Thus, the distribution of listed corals throughout the specific areas in each unit is key for determining the extent of the incremental impacts.

As described in the Records Document (Appendix A), for those islands with an abundance of records (e.g., Tutuila, Guam, Tinian, Saipan), listed corals are generally distributed throughout the specific areas being considered for proposed coral critical habitat. For example, *A. globiceps* is distributed around Guam to 12 m of depth in suitable habitats typically found on reef slopes (AKA forereef), such as the spur-and-groove, aggregate reef, and other suitable substrates included in the Guam specific area described in 3.4.5 above. The species is much rarer in other habitats, such as rubble and pavement (not being considered for proposed coral critical habitat) typically found on many reef flats. That is, *A. globiceps* is distributed throughout the specific areas being considered for proposed coral critical habitat on Guam. This also applies to the other islands and the other listed corals that are included in proposed coral critical habitat. Thus, we do not believe that there are extensive areas of proposed coral critical habitat without any colonies of listed corals, which limits the incremental impacts of proposed coral critical habitat.

That is not to say that there are no incremental impacts of proposed coral critical habitat: While listed corals are generally distributed throughout the specific areas, there are still many locations on smaller spatial scales within the specific areas that lack colonies of listed corals at any given point in time. That is, colonies of listed corals decrease or disappear from particular locations in response to changing physical or ecological conditions, then return and increase as conditions change again. For example, coral monitoring in the Tutuila Unit of the National Park of American Samoa is done annually on 15 permanently fixed transects ranging from 10 – 20 m of depth. Quadrats are photographed every 1 m along each transect, then colonies are identified to species. The exact locations are intentionally resurveyed year after year. During the 13-year period from 2007 to 2019, colonies of *A. globiceps* appeared, disappeared, and reappeared on two transects, and appeared and disappeared on two other transects. Furthermore, of the seven transects where any *A. globiceps* colonies were recorded, percent cover of the species varied from 0.0 to 1.93 percent annually (NPSA 2020). These results illustrate how colonies of listed corals may appear and disappear on small spatial scales within the specific areas of critical habitat.

Such dynamic spatial and temporal fluctuation in the distributions of the colonies of reef coral species on coral reefs, such as those of listed corals within the specific areas of critical habitat, is a natural process (Connell et al. 1997, Ninio et al. 2000). Federal actions may be proposed within critical habitat at particular locations that have no colonies of listed corals, despite the generally broad distribution of listed corals throughout the specific areas. In these cases, there would be incremental impacts of critical habitat.

3.4.20. Specific Areas and Climate Change Impacts

As noted in section 2.1 above and explained in the final listing rule (NMFS 2014), the climate change threats of ocean warming and ocean acidification pose the highest risks to the listed species. Critical habitat can contribute to the species' conservation by increasing the protection of locations where coral resilience to climate change is relatively high, such as potential thermal refugia, habitats that resemble future conditions, and any other areas that are relatively resilient to climate change. Thermal refugia occur where conditions minimize or moderate exposure of coral colonies to elevated seawater temperatures, such as lower irradiance (e.g., higher latitudes, deeper depths, cloud cover, etc.) and higher mixing (e.g., wind, currents, tides, upwelling, etc.). Habitats that resemble future conditions include backreef pools and similar areas where corals are exposed to physical factors resembling future conditions such as elevated seawater temperatures, resulting in colonies that are adapted to extremes and are thus naturally resilient to climate change. In addition, some areas may be resilient to climate change for other reasons, such as relatively pristine areas with highly diverse coral communities, islands or archipelagos surrounded by favorable oceanic conditions, habitats that are naturally highly exposed to low pH, and others (NMFS 2014, 2020).

As described in sections 3.1 and 3.4, the proposed coral critical habitat rule includes all occupied areas within U.S. waters, and the specific areas within each occupied area are delineated to include all important habitats (i.e., those with the essential feature). That is, this is a broad proposed designation that includes the full ranges of the listed species in U.S. waters, except those disqualified by sections 4(a)(3) and 4(b)(2), as described in sections 4 and 5. Thus, the specific areas already encompass potential thermal refugia, habitats that resemble future conditions, and any other relatively resilient areas. For example, any thermal refugia resulting from higher latitudes (e.g., Pagan for *A. globiceps*) or deeper depths (e.g., to 50 m on Tutuila for *A. speciosa*) are encompassed by the specific areas, because the listed species' full latitudinal and depth ranges within U.S. waters are included. The same applies to habitats that resemble future conditions (e.g., backreef pools on Ofu for *A. globiceps* and *I. crateriformis*) and other areas identified as relatively resilient to climate change (e.g., for all reef corals on Guam in Maynard et al. 2017, and on Saipan and Tinian in Maynard et al. 2015, 2018). In summary, the specific areas address climate change by inherently including all occupied areas that provide resilience. Whether unoccupied areas should also be included to address climate change is covered in the next section.

3.5. Unoccupied Areas

Section 3(5)(A)(ii) of the ESA authorizes the designation of specific areas outside the geographical area occupied by the species, if those areas are determined to be essential for the conservation of the species. Our regulations at 50 CFR 424.12(b)(2) require that we first evaluate areas occupied by the species, and only consider unoccupied areas to be essential where a critical habitat designation limited to geographical areas occupied would be inadequate to ensure the conservation of the species.

We analyzed the current ranges of the 15 listed species when considering designating unoccupied areas (NMFS 2023). These geographies were adequate to support the evolution and long-term maintenance of the species. The best available information provides no evidence that the current ranges have been reduced from the historical ranges for any of the 15 listed species. Because they still occupy their historical ranges, the essential feature is still present, and the unoccupied areas have very small amounts of habitat (<1% of current range; Table 3), we find the occupied areas adequate to ensure the conservation of the species. Thus, we are not proposing to designate any unoccupied areas within U.S. jurisdiction as critical habitat.

The impacts of global climate change-related threats (especially ocean warming and ocean acidification) to the listed corals and their habitats are projected to substantially worsen in the foreseeable future, which may result in range shifts for some or all of the 15 listed coral species. The unoccupied areas are mostly along the northern fringes of the listed species' ranges, thus ocean warming could make the ocean temperatures of these areas more suitable for the listed species in the foreseeable future. In contrast, ocean acidification is likely to have the opposite effect, causing ocean pH levels along the northern fringes of the species' ranges to become less suitable (Brainard et al. 2011, NMFS 2014). However, it is not possible to determine where such changes are likely to happen, and how they would affect the listed species' habitat.

Table 3. Estimated percentages of the current ranges of 15 ESA-listed Indo-Pacific coral species made up by unoccupied areas within U.S. waters, and their locations (NMFS 2023).

Listed Species	U.S. Unoccupied Areas	Locations
Acropora globiceps	0.6%	17 islands, including 1 in Am Samoa (Swains), 5 in CNMI (Anatahan, Sarigan, Guguan, Agrihan, Asuncion), 4 in PRIA (Kingman, Baker, Howland, Jarvis), and 7 in NWHI (Nihoa, Mokumanamana, Laysan, Lisianski, Pearl & Hermes, Midway, Kure)
Euphyllia paradivisa	<0.1%	4 islands in Am Samoa (Swains, Rose, Ofu-Olosega, Ta'u)
Acropora retusa	<0.1%	6 islands in Am Samoa (Swains), and PRIA (Palmyra, Kingman, Baker, Howland, Johnston, Jarvis)
Isopora crateriformis	<0.1%	2 islands in Am Samoa (Swains, Rose)
Acropora speciosa	<0.1%	4 islands in Am Samoa (Swains, Rose, Ofu-Olosega, Ta'u)
Acropora jacquelineae	0%	None
Acropora lokani	0%	None
Acropora tenella	0%	None
Anacropora spinosa	0%	None
Montipora australiensis	0%	None
Porites napopora	0%	None
Seriatopora aculeata	0%	None
Acropora pharaonis	0%	None
Acropora rudis	0%	None
Pavona diffluens	0%	None

4. Application of ESA Section 4(a)(3)(B)(i)

Section 4(a)(3)(B)(i) of the ESA was amended by the National Defense Authorization Act (NDAA) of 2004 to preclude the Secretary from designating as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense (DOD), or designated for its use, that are subject to a DOD Integrated Natural Resource Management Plan (INRMP) under the Sikes Improvement Act of 1997 (16 U.S.C. §670a), provided that the Secretary certifies in writing that the plan benefits the listed species. That is, DOD-controlled areas that would otherwise qualify for critical habitat are ineligible if an existing INRMP benefits the listed species within those areas.

Neither the ESA nor the 2004 NDAA defines the term "benefit." However, the conference report on the 2004 NDAA (Report 108–354) instructed the Secretary to "assess an INRMP's potential contribution to species conservation, giving due regard to those habitat protection, maintenance, and improvement projects . . . that address the particular conservation and protection needs of the species for which critical habitat would otherwise be proposed." Because a finding of benefit would result in an exemption from critical habitat designation and, given the specific mention of "habitat protection, maintenance, and improvement" in the conference report, we infer that Congress intended that an INRMP provide a conservation benefit to the habitat (e.g., essential feature) of the species, in addition to the species.

Some factors that would help us determine whether an INRMP provides a conservation benefit are provided in 2016 guidance (81 FR 7413; February 11, 2016) and our regulations at 50 CFR 424.12(h): (1) The extent of the area and features present; (2) The type and frequency of use of the area by the species; (3) The relevant elements of the INRMP in terms of management objectives, activities covered, and best management practices, and the certainty that the relevant elements will be implemented; and (4) The degree to which the relevant elements of the INRMP will protect the habitat from the types of effects that would be addressed through a destruction-or-adverse-modification analysis.

Two signed INRMPs are applicable to our proposed coral critical habitat designation: (1) The Navy's Joint Region Marianas INRMP (JRM INRMP), finalized and signed in 2019 (DON 2019a); and (2) the Air Force's INRMP for Wake Island Air Field, Wake Atoll, Kokee Air Force Station, Kauai, Hawaii, and Mt. Kaala Air Force Station, Oahu, Hawaii (Wake INRMP), finalized and signed in 2017 (USAF 2023A). Analyses of whether these two INRMPs are likely to benefit the ESA-listed corals or their habitat are provided below.

4.1. JRM INRMP

DOD-controlled marine areas in the Mariana Islands include DOD Submerged Lands. These marine areas are subject to the JRM INRMP (DON, 2019a), meaning that conservation actions described in the INRMP are carried out within them (hereafter "INRMP marine areas"). Progress on the implementation of the JRM INRMP is provided in the Navy's annual reports (DON 2019b, 2020, 2021a,b,c, 2023) and supplementary information (DON 2021d).

4.1.1. **Guam**

Guam includes three INRMP marine areas that overlap with areas considered for coral critical habitat: The Submerged Lands on Naval Base Guam – Main Base (NBG Main Base), Naval Base Guam – Telecommunications Site (NBG TS), and Andersen Air Force Base (AAFB) (DON 2019a). An analysis of whether the INRMP is likely to benefit the habitat of ESA-listed corals in each of these three INRMP marine areas is provided below, following the 4-step process described in the regulation (50 CFR 424.12(h)) and summarized above.

4.1.1.1. *Extent of The Area and Essential Feature Present*

The extent of each INRMP marine area on Guam, and the coral critical habitat essential feature within them, are summarized here:

<u>NBG Main Base Submerged Lands</u>. This INRMP marine area consists entirely of Navy Submerged Lands, designated by Presidential Proclamation 4347 in 1975, making up 30,867 acres, including approximately 3,000 acres within Apra Harbor, and approximately 30,000 acres outside the harbor along the coastline from Orote Peninsula to Asan. These Submerged Lands and their resources are described in the 2019 JRM INRMP, section 5.3 (DON 2019a), and include extensive areas of potential coral critical habitat.

<u>NBG TS Submerged Lands</u>. This INRMP marine area also consists entirely of Navy Submerged Lands, making up 19,550 acres of Submerged Lands on the northwestern side of Guam. These Submerged Lands and their resources are described in the 2019 JRM INRMP, section 8.3 (DON 2019a), and include extensive areas of potential coral critical habitat.

<u>AAFB Submerged Lands</u>. This INRMP marine area also consists entirely of Navy Submerged Lands, making up 26,529 acres of Submerged Lands on the northern side of Guam. These Submerged Lands and their resources are described in the 2019 JRM INRMP, section 9.3 (DON 2019a), and include extensive areas of potential coral critical habitat.

4.1.1.2. *Use of the Area by the Listed Species*

Each of the three INRMP marine areas on Guam include extensive coral reefs. As described in more detail in the Geographic Areas Occupied by the Species section above and also in the Records Document (Appendix A), one listed coral species, *A. globiceps*, occurs on Guam. This species is found in all three INRMP marine areas (DON 2019a).

4.1.1.3. *Relevant Elements of the INRMP (3a), and Certainty That the Relevant Elements will be Implemented (3b)*

The two parts of this step are addressed below, including 2021 and 2023 updates on progress with implementation.

3(a) Relevant Elements: The relevant elements in the INRMP for each INRMP marine area on Guam are summarized here:

NBG Main Base Submerged Lands: The INRMP includes a Coral Habitat Enhancement plan for NBG Main Base Submerged Lands (section 5.4.2.1), consisting of a Strategy and eight specific actions. Each action is listed below, along with 2021 and 2023 updates on progress:

1. Establish long-term monitoring programs to track changes in the health of corals and water quality that are compatible with existing monitoring programs in Guam and the region.
    a. 2021 Update: The FY18 final report for the water quality monitoring on NBG submerged lands project, and the FY19 final report for the coral bleaching and crown of thorns starfish (COTS) monitoring project, have been completed (DON 2018, 2019b, 2020). Both reports were shared with Guam resource partners (Guam DOAG/DAWR and NOAA NMFS). These two projects were awarded again in FY21 (DON 2021a,b,c,d).
    b. 2023 Update:
        i. The Navy has continued to implement both of these monitoring projects and is considering No Cost Extensions for both projects to continue the work. In FY23, NBG completed recurring coral surveys at the ten established long-term monitoring sites in Outer Apra Harbor, as well as four additional sites that extended off permanent transects. In particular, Western Shoals represents a site that was selected in the 2011 Guam comprehensive long-term monitoring project, which was a collaboration between federal and territory agencies as well as the University of Guam Marine Lab (DON 2023).
        ii. These two projects assist in quantifying changes in the health and water quality of marine recreational use areas (e.g., scuba diving, fishing, water sports, etc.) because they include tasks to document the presence or absence of the crown of thorns starfish (COTS) and marine invasive species, coral bleaching, and amount of living or dead colonies. Shallow water mooring systems (SWMS) buoys have been deployed in 19 locations in Apra Harbor, Orote ERA, and Dadi Beach to prevent anchoring in coral reefs, or habitats critical to endangered species and species of concern. The resulting data will allow comparisons of compare micro-habitats between areas where SWMS are present and absent which will assist in tracking changes in reef health. The identification and removal of NPBs in Guam and Tinian will also be recurring annually because illegal installations are occurring daily (DON 2023).
2. Work with regulatory partners and local subject matter experts to identify priority resilience indicators.
    a. 2021 Update: Continuously being done as part of coordination with Guam resource partners (DON 2021d). For example, implementation of a monitoring program for the detection of coral stressors and COTS/marine nuisance species control at several sites around Guam in FY21 was done in coordination with Guam resource partners (DON 2021b).
    b. 2023 Update: The Navy continues to coordinate with Guam resource partners and is currently planning to develop projects to assess coral damages and habitat state

from Typhoon Mawar that struck Guam in May 2023. Coral bleaching and COTS monitoring and water quality monitoring on JRM-administered submerged lands are ongoing and are planned to be recurring projects. In FY22, NBG Natural Resources (NR) discussed coral habitat management actions with USFWS coral experts. USFWS priority actions included to re-survey the long-term monitoring sites, which NBG executed in FY23. FY23 project data were compared to data collected in FY17 and FY20. Resilience indicators included coral diversity, coral disease, presence of stressors, percent bleached, macroalgae cover, coral size-class distribution, and COTS abundance. During the FY21 metrics meeting, NOAA Fisheries recommended that Dadi Beach be added as a sampling location for the water quality monitoring, which Navy was able to accommodate. During the FY22 metrics meeting, NOAA Fisheries commended the Navy for their effort to identify and remove NPBs in Guam because the project application included physical removal of the NPBs which positively improves coral health. The need, therefore, was extended to Tinian CNMI in FY23 (DON 2023).

3. Using the results obtained above, further refine priority sites (e.g., those that have high resilience factor) for targeted management actions.
    a. 2021 Update: For this action, since 2019 Navy has been acquiring marine resources data and working with Guam resource partners, and has determined that using two-year to five-year datasets to detect change(s) in the marine environment will inform targeted management actions and contribute to adaptive management (DON 2021d).
    b. 2023 Update:
        i. Based on the water quality monitoring project results, a potential priority site may be the Atantano Watershed to determine feasibility of restoration to promote mangrove health and adjacent coral reef ecosystems. NAVFAC Marianas recently awarded Naval Information Warfare Command Pacific (NIWC Pacific) with a project order to identify and genetically analyze ESA-listed corals on JRM submerged lands in Guam. The results of this project may further refine priority sites for targeted management actions. NAVFAC Marianas executed an Interagency Agreement (IAA) with NOAA National Centers for Coastal Ocean Science (NCCOS) to map and characterize the benthic habitat on JRM submerged lands at NBG (FY19) and NBG TS (FY20). This IAA is scheduled to end in March 2024 and the results of this project may further refine priority sites for targeted management actions (DON 2023).
        ii. The FY23 coral monitoring report compared coral resilience metrics and indicators to FY17 and FY20 reports. Average percent coral cover across the ten long-term monitoring sites in Outer Apra Harbor was 62.8% in FY23, which is similar to the average cover (60%) reported in FY17 and FY20. Over the six year period, Middle Shoals and Big Blue Reef continue to exhibit the highest health condition scores, with high heterogeneity and species richness. Monitoring site #2 (south of Delta/Echo and east of Sasa Bay) exhibits the lowest health score due to low coral cover and only six coral species; this site also has the highest prevalence of stressors, with 76.5% of coral colonies affected by sediment accumulation (DON 2023).
4. JRM has programmed for annual monitoring to include pre, during, and post monitoring around bleaching events, coral disease, and active intervention during COTS outbreaks on NBG submerged lands.

a. 2021 Update: The FY19 final report for the coral bleaching and COTS monitoring project was completed in March 2020, and was shared with Guam resource partners. This project was awarded again in FY21 (DON 2021d).
b. 2023 Update: Coral bleaching, COTS monitoring, and water quality monitoring on JRM-administered submerged lands is ongoing. These are planned to be recurring projects. The JRM Marine Invasive Species Management Plan (JRM MISMP) was finalized in October 2023. The JRM MISMP provides prevention, rapid response, control, eradication, and monitoring SOPs for marine invasive species including coral disease (e.g. Stony Coral Tissue Loss Disease) and nuisance species (e.g. COTS). One of our primary goals for marine biosecurity will include baseline surveys, to determine if any marine invasive species are present based on routine monitoring. In FY23, thermal stress was not observed across the ten long-term monitoring sites on NBG, likely due to the surveys conducted at the end of bleaching season. In FY23, the average prevalence (% of all colonies affected) of bleaching, partial bleaching, paling, and coral disease was relatively low or non-existent across all ten sites (0%, 0%, 0.3% and 0.4%, respectively; DON 2023).

5. Develop protocol for immediate assessment and response to reef damage caused by unanticipated events such as ship groundings and anchor damage.
   a. 2021 Update: The Navy developed a protocol for responding to marine mammal strandings and vessel groundings . The protocol was followed in the Navy's response to a Cuvier's Beaked Whale stranding at Dadi Beach, Guam, in 2019. The protocol will be followed to assess and respond to reef damage caused by any future ship groundings or other unanticipated events on Guam (DON 2021d).
   b. In FY22, NBG discussed priority marine habitat management actions with USFWS subject experts, who expressed support for developing a reef response plan. In FY23, NBG re-engaged with USFWS, which resulted in the establishment of an interagency agreement with USFWS Pacific Islands Fish and Wildlife Office. In addition to the response plan, the project will conclude with a training workshop for all stakeholders (DON 2023).
6. JRM will coordinate with local partners and subject matter experts (SMEs) to determine appropriate locations and methods for coral population enhancement and restoration efforts.
   a. 2021 Update: SMEs from the Navy, NOAA-NMFS, and Guam DAWR collaboratively identified an area in Apra Harbor that would be ideal for a coral translocation site for Navy projects requiring it. The area is called Mound 9. Currently, the Navy maintains Mound 9 as part of the requirement to relocate corals as a result of the harbor maintenance dredge and upgrades (DON 2021d).
   b. 2023 Update:
      i. In 2023, Navy worked with Guam Bureau of Statistics and Planning (BSP) about a potential coral nursery near the Family Beach area, which is JRM submerged lands. Although this is not an INRMP project and Navy is not committed to funding it, discussions are ongoing with BSP regarding relocating corals and fragments from the Gab Gab Beach area to the potential nursery site (DON 2023).
      ii. In 2022, NAVFAC Marianas worked with the NOAA-NMFS, CNMI DFW, and CNMI BECQ to facilitate, with assistance from the Navy Underwater Construction Team Two, the translocation of approximately 450 corals in the Tinian Harbor (DON 2023).
      iii. In 2015, in collaboratin with USFWS, the Guam Coastal Management Program, and NOAA NMFS, NBG conducted a site feasibility assessment in

Outer Apra Harbor to recommend suitable areas and measures for coral mitigation requirements from federal projects that may be proposed, which recommended that Mound 9 in Apra Harbor be used. Since then, over 10,000 coral fragments and colonies have been relocated to Mound 9 (DON 2023).

7. Reduce adverse impacts from commercial and recreational boating to coral reef habitat and EFH due to improper vessel anchoring by installing and maintaining mooring buoys at 19 locations within NBG Main Base submerged lands: Outer Apra Harbor (15) and the south side of Orote Peninsula (4).
   a. 2021 Update: In 2020, Navy installed the shallow water mooring system (SWMS) buoys on submerged lands in Apra Harbor and Orote Ecological Reserve Area (ERA) for marine recreational users to avoid anchoring and minimize damage to the coral reef. In addition, in 2021, Navy has an ongoing project to identify and remove all non-permitted buoys in Apra Harbor and Orote ERA, and check the condition of the SWMS buoys (DON 2021b,d).
   b. 2023 Update: As noted under #1 above, one project has been completed and another is underway to identify and remove non-permitted buoys (NPBs) from JRM submerged lands (DON 2023).
8. Participate in bi-annual Guam Coral Reef Task Force (CRTF) and the reef restoration working group.
   a. 2021 Update: Navy marine resources SMEs continue to participate in the annual Guam CRTF meetings, watershed working group, and reef restoration working group (DON 2021d).
   b. 2023 Update: In August 2022, NAVFAC Marianas representatives attended the USCRTF meeting in Kona, HI to participate in various working groups, establish networks with marine resource managers, and obtain training in marine resource management. In August 2023, NAVFAC Marianas representatives attended the Pacific US States and Territories Coral Restoration Symposium, which included partners from UOG Marine Laboratory, Reef Resilience Network, the Guam Bureau of Statistics & Plans, NOAA, and the National Fish and Wildlife Foundation (DON 2023).

<u>TS Submerged Lands</u>. The INRMP includes a Coral Habitat Enhancement plan for NBG TS Submerged Lands (section 8.4.2.1), consisting of a Strategy and eight specific actions patterned after the NBG Main Base actions listed above.

1. 2021 Update: Seven of the eight actions (#1-6 and #8) are the same for NBG Main Base and NBG TS, and the 2021 updates are the same for NBG TS as for NBG Main Base for those seven actions (DON 2021d). For Action #7, the NBG Main Base action is to install and maintain 19 mooring buoys, whereas the NBG TS action is to install and maintain 1 buoy (Double Reef), because there is much less boat traffic within the NBG TS submerged land area than the NBG Main Base submerged land area (DON 2019a). For this NBG TS action, a buoy was installed at Double Reef in 2020, but has since been lost to storm surge. The Navy is planning to replace the buoy in 2022 (DON 2021d).
2. 2023 Update: The updates for TS are the same as those from NBG – water quality monitoring, coral bleaching and COTS monitoring, and JRM MISMP. In 2023, the Navy awarded a contract to identify and genetically analyze ESA-listed corals on JRM submerged lands in Guam, as well as identification and removal of NPBs on JRM submerged lands in Tinian CNMI. The results of this project may further refine priority sites for targeted management actions. Additionally, we established an Interagency Agreement (IAA) with NOAA National Centers for Coastal Ocean Science (NCCOS) to map and characterize the benthic habitat on JRM submerged lands at NBG (FY19) and NBG TS (FY20). This IAA is

scheduled to end in March 2024 and the results of this project may further refine priority sites for targeted management actions. SWMS buoys have been installed in Apra Harbor, Orote ERA, and Dadi Beach. More SWMS installations will be planned for Haputo ERA, Pati Point, and Tinian CNMI (DON 2023).

AAFB Submerged Lands. The INRMP includes a Coral Habitat Enhancement plan for AAFB Submerged Lands (section 8.4.2.1), consisting of a Strategy and seven specific actions that are the same as for NBG Main Base, except that there is no mooring buoy action (DON 2019a), because the AAFB submerged waters are infrequently used by boats that would use such moorings.

1. 2021 Updates: Seven AAFB actions are the same as for NBG Main Base, except that for Action #4 (COTS monitoring), there was less COTS monitoring conducted in AAFB submerged lands than at NBG Main Base because historically COTS outbreaks have not been detected in AAFB waters (DON 2021d).
2. 2023 Updates: The updates for AAFB are the same as those from NBG and TS (DON 2023).

3(b) Certainty that Relevant Elements Will be Implemented. Part of this factor is the certainty that the relevant elements will be implemented. NMFS has certainty that the Navy will implement the elements of the JRM INRMP related to coral habitat within all INRMP marine areas in Guam for three reasons: (1) clear and recent documentation of marine conservation work in Guam; (2) good faith efforts by the Navy to conserve corals and their habitat in Guam; and (3) a Navy history of marine conservation work in Guam, as explained in more detail below:

1. Clear and Recent Documentation: As described above, the 2019 JRM INRMP includes Coral Habitat Enhancement plans for INRMP marine areas in Guam, with clear strategies and actions that address the habitat conservation needs of ESA-listed corals within these areas. The JRM INRMP's Appendix D also includes annual reports describing how coral conservation efforts had been implemented in the years leading up to the 2019 final INRMP. These coral habitat conservation plans, as well as progress reports from the most recent years (DON 2019b, 2020, 2021a,b,c,d), clearly articulate how Navy is conserving coral habitat within the INRMP marine areas in Guam, and how it is planning to do so in the future.
2. Demonstration of Good Faith Efforts for Listed Corals: Navy has already implemented coral habitat conservation projects that are beneficial to ESA-listed corals within some INRMP marine areas in Guam, as described in the INRMP itself and its Appendix D (DON 2019b), as well as progress reports (DON 2019b, 2020, 2021a,b,c,d). Many of these projects have been ongoing for several years and are proactive, in that they were not required of the Navy by the ESA.
3. History of Strong Conservation Work: In our experience working with the Navy on the development of the marine resource components of its 2013 and 2019 final INRMPs (DON 2013, 2019a), we have found the Navy to be successful at carrying out marine habitat conservation work on Guam, and that it often takes the initiative on conservation efforts whether requested by NMFS or not. For example, many of the coral habitat conservation projects in the 2019 JRM INRMP (DON 2019a) and progress reports (DON 2019b, 2020, 2021a,b,c,d, 2023) had already been started by the Navy before corals were listed in 2014, and were being done to improve conservation of marine resources on the island, regardless of whether they were required by federal statute or not.

4.1.1.4. *Degree to Which INRMP Will Protect Coral Habitat*

Finally, we must consider the degree to which the relevant elements of the JRM INRMP will protect the essential feature of coral critical habitat (reproductive, recruitment, growth, and maturation habitat) from the types of effects that would be addressed through critical habitat consultation, i.e., the destruction-or-adverse-modification analysis. That is, how does the protection of the essential feature within the INRMP marine areas in Guam provided by the INRMP compare to that provided by critical habitat via section 7 consultations between NMFS and the Navy. If fully implemented, the coral habitat enhancement elements of the JRM INRMP described above will substantially reduce the types of effects within the INRMP marine areas in Guam that would be addressed through the destruction-or-adverse-modification analysis. Navy would accomplish this primarily by using the results of its own monitoring program to develop and implement management measures to minimize the impacts of Navy's actions in Guam on coral habitat within the INRMP marine areas. Thus, implementation of the JRM INRMP is likely to provide substantial protection to the essential feature of coral critical habitat (reproductive, recruitment, growth, and maturation habitat) within the Guam INRMP marine areas from the types of effects that would be addressed through critical habitat consultation (DON 2021a,b,d, 2023).

4.1.2. CNMI

CNMI includes two INRMP marine areas – the Submerged Lands of the Tinian Marine Lease Area (Tinian MLA) and around Farallon de Medinilla (FDM; DON 2019a). The Tinian MLA's Submerged Lands include over half of the potential coral critical habitat on Tinian. FDM's Submerged Lands encompass all potential coral critical habitat on FDM. An analysis of whether the JRM INRMP is likely to benefit the habitat of ESA-listed corals in these two INRMP marine areas in CNMI is provided below, following the 4-step process described in the regulation (50 CFR 424.12(h)) and summarized in the introduction to section 4 above.

4.1.2.1. *Extent of The Area and Essential Feature Present*

The extent of each INRMP marine area in CNMI, and the coral critical habitat essential feature within them, are summarized here:

<u>Tinian MLA</u>. The Tinian MLA consists of 47,418 acres of Navy Submerged Lands surrounding the northern portion of Tinian. These Submerged Lands and their resources are described in the 2019 JRM INRMP, section 11.3 (DON 2019a), and include extensive areas of potential coral critical habitat.

<u>FDM Submerged Lands</u>. The FDM Submerged Lands consist of 25,094 acres of Navy Submerged Lands surrounding the island. These Submerged Lands and their resources are described in the 2019 JRM INRMP, section 12.3 (DON 2019a), and include extensive areas of potential coral critical habitat.

4.1.2.2. *Use of the Area by the Listed Species*

Each of the two INRMP marine areas in CNMI include extensive coral reefs. As described in more detail in the Geographic Areas Occupied by the Species section above and also in the Records Document (Appendix A), one listed coral species, *A. globiceps*, occurs on both Tinian and FDM. This species is found in both INRMP marine areas (DON 2019a).

4.1.2.3. *Relevant Elements of the INRMP (3a), and Certainty That the Relevant Elements will be Implemented (3b)*

The two parts of this step are addressed below, including 2021 and 2023 updates on progress with implementation.

3(a) Relevant Elements: The relevant elements in the INRMP for each INRMP marine area in CNMI are summarized here:

<u>Tinian MLA</u>. The relevant elements in the INRMP for the Tinian MLA are summarized here. The INRMP includes a Coral Habitat Enhancement plan for the Tinian MLA (section 11.4.2.1), consisting

of a Strategy and three specific actions. Each action is listed below, along with 2021 and 2023 updates on progress:

1. Establish long-term monitoring programs to track changes in the health of corals and water quality that are compatible with existing monitoring programs in Guam and the CNMI.
    a. 2021 Update: In 2020, the Navy coordinated with NMFS (PIRO and PIFSC) on the NOAA research vessel Rainiers' planned expedition to the Marianas for the 2021 Mariana Reef Assessment and Monitoring Program (MARAMP) surveys. However, due to the COVID-19 pandemic the MARAMP was postponed but the Navy continues to coordinate with NMFS to obtain datasets and products being collected by MARAMP. These surveys generally occur every 3-5 years, depending on the availability of the research vessel. The surveys are beneficial to the Navy's marine resources program, as well as other state and federal marine resources programs, because the Rainier can operate in isolated areas that require significant amounts of resources to access and work in (DON 2021d).
    b. 2023 Updates:
        i. In FY22, a cooperative agreement with UOG Water Environmental Research Institute (UOG WERI) was executed to perform water quality monitoring in the Tinian MLA and Tinian Harbor (compensatory mitigation and offset for the Tinian Harbor repairs). The water quality monitoring sensors will be deployed by late 2023 or early 2024 upon sensor maintenance and coordination with the CNMI resource partners for permitting requirements. This project is planned to be recurring (DON 2023).
        ii. The JRM Marine Invasive Species Management Plan (JRM MISMP) is scheduled to be finalized near the end of 2023. The JRM MISMP provides prevention, rapid response, control, eradication, and monitoring SOPs for marine invasive species including coral disease (e.g. Stony Coral Tissue Loss Disease) and nuisance species (e.g. COTS). The Navy's goal for marine biosecurity will include baseline surveys to determine if any marine invasive species are present and essentially conduct routine monitoring (DON 2023).
        iii. In FY23, identification and removal of non-permitted buoys was extended from Guam to JRM submerged lands in Tinian CNMI and the field work is scheduled for September 2024. The identification and removal of NPBs in Guam and Tinian will also be recurring annually because illegal installations are occurring daily (DON 2023).
2. Establish a monitoring program for the detection of coral bleaching and disease within JRM Submerged Lands. Monitoring methodology will be coordinated with resource partners.
    a. 2021 Update: This action is scheduled for 2022 (DON 2021d).
    b. 2023 Update: This action is onging with UOG Sea Grant to monitor coral bleaching and COTS in the Tinian MLA and also areas around the Tinian Harbor (compensatory mitigation and offset for Tinian Harbor repairs; DON 2023).
3. Establish a COTS monitoring and control program based on best available methods that are effective in JRM Submerged Lands to reduce COTS predation on corals and fish in Essential Fish Habitat (EFH). When COTS control is enacted, it will include monitoring pre, during, and post-intervention.
    a. 2021 Update: This action is scheduled for 2022 (DON 2021d).
    b. 2023 Update: This action is onging with UOG Sea Grant to monitor coral bleaching and COTS in the Tinian MLA and also areas around the Tinian Harbor (compensatory mitigation and offset for Tinian Harbor repairs). NAVFAC MAR will prioritize this project and intends to fund it annually. In May 2022, a two-day COTS

workshop, consisting of a classroom and in-water portion, was held in Guam with participants from the local and federal government, private businesses, and NGOs in Guam. NAVFAC MAR coordinated the workshop with UOG Sea Grant and UOG Marine Lab's COTS expert Dr. Ciemon Caballes. Dr. Caballes discussed the biology, ecology, history, and distribution of COTS, monitoring and surveillance techniques, and control and culling techniques. The workshop enabled participants to conduct in-water surveys via snorkeling and manta-tow, and also trained participants to use the COTS applicator/injector for COTS control and culling. In March 2023, the coral bleaching and COTS monitoring training was held in Saipan CNMI to train CNMI resource partners, NGOs, and marine recreational users from the community about the biology and culling techniques for COTS (DON 2023).

FDM Submerged Lands. The relevant elements in the INRMP for the FDM Submerged Lands are summarized here. The INRMP includes a Marine Habitat Management plan for the FDM marine area (section 12.4.2.1), consisting of surveys and mapping of coral reef and other marine habitats within the area. The INRMP also includes assessment of ESA-listed corals, as required by the 2015 biological opinion on the Navy's Mariana Islands Testing and Training program (section 12.4.2.2, DON 2019a).

1. Surveys and mapping of coral reef and other marine habitats within the area.
    a. 2021 Update: A mapping contract was awarded by the Navy to NCCOS in 2018, the aerial imagery and LiDAR collected in 2020, and the mapping is scheduled for completion by 2023. These maps will be for 0 – 33 m of depth (DON 2021d).
    b. 2023 Update:
        i. LiDAR raw data collected in 2020 has not yet been analyzed.
        ii. In 2022, NOAA-NMFS completed the MARAMP expedition in the Marianas which included the islands of Guam, Tinian CNMI, and FDM CNMI. These islands fall under the JRM area of responsibility and it is beneficial to work with NOAA-NMFS to obtain data products to assist in the conservation and management efforts of marine resources in these areas. During range closure, which occurs approximately every two to five years, marine resources surveys are conducted in FDM nearshore waters which is funded by the Navy. The results of these surveys are shared with the resource partners (DON 2023).
2. Assessment of ESA-listed corals, as required by the 2015 biological opinion on the Navy's Mariana Islands Testing and Training program. Initial survey completed in 2017 and report provided to NMFS in 2018.
    a. 2021 Update: Due to the restrictions associated with FDM access (i.e., active range), the surveys can only be done every three to five years, and the next survey is planned for 2022 (DON 2021d).
    b. 2023 Update: As noted above, the MARAMP expedition in 2022 included FDM, during which assessment of ESA-listed corals was done (DON 2023).

3(b) Certainty that Relevant Elements Will be Implemented.

Part of this factor is the certainty that the relevant elements will be implemented. NMFS has high certainty that the Navy will implement the elements of the JRM INRMP for the INRMP marine areas in CNMI (Tinian MLA, FDM Submerged Lands) for three reasons: (1) clear and recent documentation of marine conservation work in the Mariana Islands; (2) good faith efforts by the Navy to conserve corals and their habitat in the Mariana Islands; and (3) a Navy history of marine conservation work in the Mariana Islands, as explained in more detail below:

1. Clear and Recent Documentation: As described above, the 2019 JRM INRMP includes Coral Habitat Enhancement plans for INRMP marine areas in CNMI (Tinian MLA, FDM Submerged Lands), with clear strategies and actions that address the habitat conservation needs of ESA-listed corals within these areas. The JRM INRMP's Appendix D also includes annual reports describing how coral conservation efforts had been implemented in the years leading up to the 2019 final INRMP. These coral habitat conservation plans, as well as progress reports from the most recent years (DON 2019b, 2020, 2021a,b,c,d, 2023), clearly articulate how Navy is conserving coral habitat within the INRMP marine areas in CNMI, and how it will do so in the future.
2. Demonstration of Good Faith Efforts for Listed Corals: Navy has already implemented coral projects that have the potential to benefit the habitat of ESA-listed corals within INRMP marina areas in CNMI (Tinian MLA, FDM Submerged Lands). For example, coral species presence and abundance surveys were conducted within the Tinian MLA in 2013 (Tetra Tech 2014) and 2017 (DON, 2017), and around FDM in 2012 (Smith and Marx, 2016), 2017 (Carilli et al., 2018), and 2022 (DON 2023). While more recent planned surveys had to be postponed because of the pandemic, they will be resumed soon, as described above. These surveys have the potential to benefit the habitat of ESA-listed corals by providing information needed to better protect these areas in the future.
4. History of Strong Conservation Work: In our experience working with the Navy on the development of the marine resource components of its 2013 and 2019 final INRMPs (DON 2013, 2019a), we have found the Navy to be successful at carrying out marine habitat conservation work in the Mariana Islands, and that it often takes the initiative on conservation efforts whether requested by NMFS or not. For example, many of the coral habitat conservation projects in the 2019 JRM INRMP (DON 2019a) and progress reports (DON 2019b, 2020, 2021a,b,c,d, 2023) had already been started by the Navy before corals were listed in 2014. These projects were being done to improve conservation of marine resources on the island, regardless of whether they were required by federal statute or not. While the majority of these projects have been implemented in Guam rather than CNMI, the JRM INRMP includes many plans for CNMI (as noted above), and the same Navy office (Navy Facilities Marianas) is responsible for carrying out such work in both Guam and CNMI.

4.1.2.4. *Degree to Which INRMP Will Protect Coral Habitat*

Finally, we must consider the degree to which the relevant elements of the JRM INRMP will protect the essential feature of coral critical habitat (reproductive, recruitment, growth, and maturation habitat) from the types of effects that would be addressed through critical habitat consultation, i.e., the destruction-or-adverse-modification analysis. That is, how does the protection of the essential feature within the INRMP marine areas in CNMI (Tinian MLA and FDM Submerged Lands) provided by the INRMP compare to that provided by critical habitat via section 7 consultations between NMFS and the Navy. If fully implemented, the coral habitat enhancement elements of the JRM INRMP described above will substantially reduce the types of effects within the INRMP marine areas in CNMI that would be addressed through the destruction-or-adverse-modification analysis. Navy would accomplish this primarily by using the results of its own monitoring program to develop and implement management measures to minimize the impacts of Navy's actions in CNMI on coral habitat within the INRMP marine areas. Thus, implementation of the JRM INRMP is likely to provide substantial protection to the essential feature of coral critical habitat (reproductive, recruitment, growth, and maturation habitat) within the CNMI INRMP marine areas from the types of effects that would be addressed through critical habitat consultation (DON 2021a,c,d, 2023).

4.1.3. Conclusion for JRM INRMP

In conclusion, based on our determination of the regulatory factors, the JRM INRMP (DON 2019a) will benefit the habitat of listed corals in all of Guam's and CNMI's INRMP marine areas, because: (1) extensive habitat area and essential feature occurs within the INRMP marine areas; (2) these areas are used extensively by one listed coral species, *A. globiceps*; (3) the INRMP provides a conservation benefit to the species and its habitat; and (4) the INRMP's relevant elements will protect the habitat of listed corals from the types of effects that would be addressed through a destruction-or-adverse-modification analysis (i.e., section 7 analyses).

4.2. Wake Atoll INRMP

The waters surrounding Wake Atoll out to 12 nautical miles are part of the U.S. National Wildlife Refuge System managed by the U.S. Fish and Wildlife Service. However, in 1972, the Departments of the Interior and Defense signed an agreement granting the U.S. Air Force (USAF) full authority for civil administration of the atoll, thereby giving DOD control of access and use of these waters (USAF 2015, Appendix D). This DOD-controlled marine area is subject to the Wake INRMP (USAF 2023a), meaning that conservation actions described in the Wake INRMP affect the waters within and surrounding the atoll (hereafter "INRMP marine area"). This INRMP marine area (shown in Fig. 5-10, USAF 2023a) encompasses all potential coral critical habitat around the atoll. Progress on the implementation of the Wake INRMP is provided in the Air Force's updates (USAF 2018, 2019, 2021a, 2023b) and supplementary information (USAF 2021b). An analysis of whether the INRMP is likely to benefit the habitat of ESA-listed corals in the INRMP marine area is provided below, following the 4-step process described in our regulations at 50 CFR 424.12(h).

4.2.1. Wake Atoll

An analysis of whether the INRMP is likely to benefit the habitat of ESA-listed corals in this INRMP marine area is provided below, following the 4-step process described in the regulation (50 CFR 424.12(h)) and summarized in the Introduction to section 4.

4.2.1.1. *Extent of The Area and Essential Feature Present*

The Wake INRMP marine area includes 495,515 acres of Submerged Lands and waters within the lagoon and surrounding the atoll out to 12 nautical miles from the mean low water line (USAF 2023a), and thus includes all reef-building corals and coral reefs associated with the atoll. A coral survey conducted in 2005 around the entire circumference of Wake Atoll at approximately 9 – 29 m (30 – 95 ft) depth documented 101 reef-building coral species and 36 percent live coral cover. USFWS conducted a coral reef survey on Wake in August 2016, recording reef type and condition as well as coral species (Foster et al. 2017). Based on this information, we conclude that the essential feature is widespread around this INRMP marine area.

4.2.1.2. *Use of the Area by the Listed Species*

The Wake INRMP marine area includes extensive coral reefs. As described in more detail in the Geographic Areas Occupied by the Species section above and also in the Records Document (Appendix A), *A. globiceps* and *A. retusa* occur on Wake. The species are found throughout the coral reefs that surround the atoll (Appendix A).

4.2.1.3. *Relevant Elements of the INRMP (3a), and Certainty That the Relevant Elements will be Implemented (3b)*

The two parts of this step are addressed below, including 2021 and 2023 updates on progress with implementation.

3(a) Relevant Elements: The relevant elements in the Wake INRMP for the INRMP marine area are summarized here. The Wake INRMP (USAF 2023a) includes a coral conservation component (Appendix K, Coral Conservation Actions at Wake Atoll), made up of four groups of actions: water quality improvements, education and outreach, fisheries management, and physical DOD presence on Wake Atoll. Each group of actions consists of several projects, listed below. The INRMP provides a project or contract number for each project, as well as a description of how each project is expected to benefit ESA-listed corals, along with 2021 and 2023 updates on progress.

1. Water Quality Improvement Actions:
    a. Wake Stormwater Pollution Prevention.
        i. 2021 Update: Stormwater Pollution Prevention Plan certified in May 2021, and submitted to EPA for National Pollution Discharge Elimination System (NPDES) permit coverage (USAF 2021a,b).
        ii. 2023 Update: Wake Island Airfield Stormwater Pollution Prevention Plan certified in November 2021 (USAF 2023b).
    b. Spill Prevention Control and Countermeasure Plan.
        i. 2021 Update: 5-year revision of Spill Prevention Control and Countermeasure Plan completed in April 2021. Annual updates on track as required (USAF 2021a,b).
        ii. 2023 Update: Spill Prevention, Control, and Countermeasure Plan finalized in March 2021. Per 40 CFR 112.5, the SPCC plan is reviewed and evaluated once every five years. Annual reviews and updates are completed as required (USAF 2023b).
    c. National Pollution Discharge Elimination System – Reverse Osmosis Permit.
        i. 2021 Update: Permit MW0020338 effective date of August 1, 2021. All Monitoring requirements have been met for the first 3 quarters of the new permit (USAF 2021a,b).
        ii. 2023 Update: Permit No MW0020338 effective date of Aug 1, 2021, expiration of July 31, 2026. All monitoring requirements have been met (USAF 2023b).
    d. Invasive Species – Ironwood Removal and Rat Eradication.
        i. 2021 Update: For Ironwood Removal, 21.5% of all ironwood coverage on Wake was removed between 2016 and 2020 (USAF 2021a). In the process of obtaining permits for additional ironwood removal (USAF 2021b). For Rat Eradication, made progress with preparation (NEPA EA for pesticide use, bait trials,) for eradication in late 2022 or 2023 (USAF 2021a).
        ii. 2023 Updates:
            1. For non-native vegetation removal the focus remains on Ironwood. NEPA has been completed and finalized EA is in place. Ground action to begin removal of Ironwood in proximity to the airfield is anticipated to begin in 2024 (USAF 2023b).
            2. For Rat Eradication, a funding effort is currently underway with planning and preparations and main baiting operations anticipated during 2024 (USAF 2023b).
            3. In addition, efforts are underway to complete baseline surveys for priority arthropods, specific tamp ants with initial focus on Yellow Crazy Ants. Survey work is anticipated in October/November 2023. Depending on survey results, appropriate follow-up management planning will be developed (USAF 2023b).

4. The Wake Island Airfield Biosecurity Plan update progress began in 2023, a finalized update is anticipated in 2024. The updated biosecurity plan is expected to strengthen language and clarify requirements to better ensure compliance and reduce risk of novel organism movements to and from the installation (USAF 2023b).

e. Native Ecosystems Management.
    i. 2021 Update: As noted above ironwood removal is ongoing. Also, native vegetation workplan completed (USAF 2021a). Additional ironwood removal planned (USAF 2021b).
    ii. 2023 Update: Environmental Assessment (EA) to support Ironwood removal has been completed. Contract has been awarded to conduct Ironwood removal proximal the airfield in compliance with the EA and expectations are that ground efforts will begin in 2024 (USAF 2023b).

f. Wetland and Floodplain Management.
    i. 2021 Update: Wetland delineation included in most recent Programmatic Environmental Assessment contract (USAF 2021b).
    ii. 2023 Update: Contract awarded for Wetlands Delineation at Wake Island Airfield, which will be conducted as part of the Programmatic EA (PEA) for WIA demolition and improvement projects. The final delineation report is scheduled to be completed by January 2024 (USAF 2023b).

2. Education and Outreach:
    a. Outdoor Recreation and Public Access to Natural Resources, Outreach (on actions to reduce likelihood of impacts on corals).
        i. 2021 Update: In response to an increase in fishing infractions, in 2020 and 2021, plans were made to increase outreach about fishing, including trainings on fishing regulations, requirement for fishing licenses, and fishing gear checks (USAF 2021a,b).
        ii. 2023 Update: Contract awarded for Outdoor Cantilevered Exhibit Base Interpretative Signs to develop and produce three full-color fishing program interpretive signs on Aluminum Cantilevered Exhibit Base w/Aluminum Brochure Holder for brochures. To be mounted at high traffic fishing access points on WIA. Three Aluminum Wall Mounted panels to be installed in the Hangar, Dining Facility (DFAC), and at another pre-determined location. Each shall have a pamphlet holder installed separately next to the sign. Information will include info on threatened, endangered, and protected marine species including coral and restrictions against collecting or damaging any coral and other NR info. Panel and pamphlet layout and information will be submitted to NOAA-NMFS and USFWS for review/comment before final design is approved and materials are produced (USAF 2023b).
    b. Wake Island Dive Club Memorandum (on actions to reduce likelihood of contact with corals).
        i. 2021 Update: A new Wake Island Dive Club Charter is in draft stages with coordination by Command on Wake (USAF 2021b).
        ii. 2023 Update: Updated Dive club charter and included in the published 2023 version of the Wake Island INRMP. Added new natural resources requirements to include reporting, standoff distance from marine species, and requirements for diving around all coral. However, as of September 2023, there was no Wake Island Dive Club (USAF 2023b).
3. Fisheries Management:

a. Wake Island Operating Guidance – Environmental Compliance and Protection of Natural Resources.
    i. 2021 Update: With regard to the management of recreational fishing, several steps have been taken or will be taken, including revision of the fishing log, providing fish species identification guides and fish measuring rulers to island residents who have fishing licenses, providing trainings on fishing regulations, and only allowing approved fishing gear on to the island (USAF 2021a,b)
    ii. 2023 Update:
        1. Recent updates to the Wake Island Operating Guidance include updated fishing regulations, new requirements for barbless hooks and procedures for unintentional catch of sea turtles and other species. All personnel arrive at Wake Island are provided with an environmental orientation upon arrival that details protected resources on the island. A separate fishing training is required to obtain a fishing permit. The training covers fishing regulations, specific species that can be caught and kept, species that must be released to the water immediately and details of the fishing log requirement. The INRMP requires fishing logs to be completed for each fish caught and submitted monthly for personnel, or every two weeks for visitors (USAF 2023b).
        2. As of September 15, 2023, the WIA fishing program is out of compliance with the Wake Island INRMP. The Base Operating Support (BOS) contractor is not submitting any records of the training, permits or fishing logs so there is no proof that the INRMP requirements are being met. The Air Force is meeting internally to address this issue. The Air Force is working collaboratively with the USFWS Monument Superintendent to determine the next steps (USAF 2023b).

b. Management of ESA-listed Corals (species surveys of all coral and coral reef habitats of Wake Atoll, including lagoon, reef flats, and slopes).
    i. 2021 Update: Reef slope survey completed in 2016 and report provided in 2017 (Foster et al. 2017). Lagoon survey completed in May 2021 by FWS, USAF awaiting report from FWS (USAF 2021a,b).
    ii. 2023 Update: Project "Coral Reef Resources and Marine Habitat Characterization of Wake Atoll Lagoon and Western Reef Flat, Wake Atoll" and Final Report received August 2022. The FY19 funding was used to initiate a marine benthic mapping characterization exercise and identify federally listed coral species in the Wake Atoll lagoon. The FY19 activities were completed in May 2021 as the Fish and Wildlife Resource Report, Coral Reef Resources and Marine Habitat Characterization of Wake Atoll Lagoon. For FY20, the global pandemic delayed the site visit to Wake Island. PIFWO completed a site visit in April 2022 that continued the FY19 benthic habitat mapping, identifying locations of additional federally listed corals, and collecting baseline information on the population of *Tridacna* (giant clams; USAF 2023b).

c. Management of Fish Populations.
    i. 2021 Update: Coral reef fish survey funded, fishing activity closely monitored and report included, management changes proposed including more law enforcement and more detailed fishing logging (USAF 2021a).

    ii. 2023 Update: USFWS Interagency Agreement completed in 2022 and funding issued to the USFWS in April 2023. Fieldwork planned to start in FY24. The FY23 funds will prioritize and support tasks on a funds-available basis (USAF 2023b).
  d. Management of Bumphead Parrotfish and Humphead Wrasse.
    i. 2021 Update: Survey contract awarded, work to start in 2022 (USAF 2021a).
    ii. 2023 Update: Agreement with NOAA-NMFS (PIFSC) to conduct "Bumphead Parratfish & Humphead Wrasse" project signed in July 2023. NOAA-PIFSC will conduct a series of research activities that will ultimately inform the development of a survey design for Wake Atoll that is optimized for comprehensive monitoring of multiple life-history stages of the following priority species: humphead wrasse (*Cheilinus undulatus*), bumphead parrotfish (*Bolbometopon muricatum*), and scalloped hammerhead shark (*Sphyrna lewini*; USAF 2023b).

4. Physical DOD Presence on Wake Atoll:
  a. Public Access Restrictions (32 CFR Part 935 Wake Island Code).
    i. 2021 Update: Unchanged but already highly restrictive.
    ii. 2023 Update. Unchanged but already highly restrictive (USAF 2023b).
  b. INRMP 5 Year Review and Update.
    i. 2021 Update: Letter of Intent to do 5 Year Review sent by USAF to NMFS/PIRO in November 2021.
    ii. 2023 Update. Unchanged but already highly restrictive (USAF 2023b).
  c. INRMP Annual Review and Update.
    i. 2021 Update: 2020 review provided (USAF 2021a).
    ii. 2023 Update. Unchanged but already highly restrictive (USAF 2023b).

3(b) Certainty that Relevant Elements Will be Implemented. Part of this factor is the certainty that the relevant elements will be implemented. NMFS has high certainty that USAF will implement the ESA-listed coral elements of the Wake INRMP because of clear and recent documentation, good faith efforts by USAF to conserve ESA-listed corals on Wake Atoll, and a USAF history of strong conservation work on Wake Atoll:

1. Clear and Recent Documentation: As described above, the Wake INRMP includes a coral conservation plan (USAF 2023a, Appendix K) with a 4-pronged strategy (water quality improvement, outreach and education for Wake-based staff, fisheries management, and physical DOD presence on Wake Atoll i.e., restriction of access and overall natural resource management) that comprehensively addresses the conservation needs of ESA-listed corals on Wake Atoll. This coral conservation plan clearly articulates how USAF is conserving corals on Wake, and how it will do so in the future. The ongoing implementation of the Wake INRMP is reported via progress updates and reviews (USAF 2018, 2019, 2021a,b, 2023b).
2. Demonstration of Good Faith Efforts for Listed Corals: In the years leading up to the final Wake INRMP (USAF 2023a), USAF implemented projects on Wake related to each of its 4-pronged coral conservation strategy, as explained in Appendix S of the Wake INRMP. For water quality improvement, in 2016 USAF began implementation of both the stormwater pollution prevention and invasive plant control projects. For outreach and education, in 2016 USAF revised the Wake Island Dive Club Charter to further reduce the potential impacts of recreational activities on corals. For fisheries management, in 2017 USAF updated its fishing rules, which are part of the Wake Island Operating Guidance (Appendix O of the 2017 Wake INRMP) to prohibit the use of (1) cast nets on the exterior of the atoll, (2) anchoring on coral reef habitat, and (3) and trolling over coral reef habitat. For physical

DOD presence on Wake Atoll, in 2016 USAF funded and provided logistical support for a FWS coral survey that documented two ESA-listed corals on the atoll for the first time. Since 2017, USAF has implemented projects on Wake for each of its 4-pronged coral conservation strategy, as noted above in the 2021 updates, and detailed in the progress updates and reviews (USAF 2018, 2019, 2021a,b, 2023b).

3. History of Strong Conservation Work: USAF has a long history of carrying out successful conservation work on Wake, and often takes the initiative on conservation efforts whether requested by NMFS or not. For example, many of the projects in the INRMP's coral conservation strategy had already been started by USAF before corals were listed in 2014, and were being done to improve conservation of marine and terrestrial resources on the atoll, regardless of whether they were required by federal statute or not. Likewise, in 2016, USAF funded and supported the FWS coral survey of the atoll, leading to the discovery of two ESA-listed corals. In addition, USAF has historically been a strong conservation partner with NMFS and FWS, supporting a wide variety of marine and terrestrial conservation projects, and actively engaging both agencies in the INRMP planning and implementation process, as described in the progress updates and reviews (USAF 2018, 2019, 2021a,b, 2023b).

4.2.1.4. *Degree to Which INRMP Will Protect Coral Habitat*

Finally, we must consider the degree to which the relevant elements of the Wake INRMP will protect the essential feature of coral critical habitat (reproductive, recruitment, growth, and maturation habitat) from the types of effects that would be addressed through critical habitat consultation, i.e., the destruction-or-adverse-modification analysis. Because all federal actions at Wake are controlled by USAF, the question is how does the protection of the essential feature within INRMP marine area provided by the INRMP compare to that provided by critical habitat via section 7 consultations between NMFS and USAF? If fully implemented, the coral conservation component of the Wake INRMP (Appendix K, Coral Conservation Actions at Wake Atoll) is expected to reduce both direct and indirect impacts to listed corals via minimization or avoidance of recreational impacts (fishing, diving, anchoring), and terrestrial impacts (i.e., run-off from land-based activities; USAF, 2023a), thereby addressing two of the primary threats to listed corals (fishing and land-based sources of pollution). Based on the fact that the Wake INRMP's coral conservation strategy is well-designed to reduce impacts to listed corals, and also that recent progress updates and reviews (USAF 2018, 2019, 2021a,b, 2023b) demonstrate substantial progress with the implementation of the strategy, we determined that the Wake INRMP provides a benefit to listed corals; and their critical habitat (reproductive, recruitment, growth, and maturation habitat).

4.2.2. **Conclusion for Wake INRMP**

In conclusion, based on the above factors, we determined that the Wake INRMP (USAF 2023a) will benefit the habitat of listed corals, because: (1) extensive habitat area and essential feature occurs within the INRMP marine areas; (2) these areas are used extensively by the listed coral species, *A. globiceps*; (3) the INRMP provides a conservation benefit to these species and their habitats; and (4) the INRMP's relevant elements will protect the habitat of listed corals from the types of effects that would be addressed through a destruction-or-adverse-modification analysis (i.e., section 7 analyses).

4.3. 4(a)(3) Conclusion

Based on the above analyses, we determined that the implementation of the JRM INRMP (DON 2019a) and the Wake INRMP (USAF 2023a) both provided a benefit to the habitats of ESA-listed coral species within INRMP marine areas on Guam, Tinian, FDM, and Wake. Thus, the potential coral critical habitat within the INRMP marine areas on Guam, Tinian, FDM, and Wake is ineligible for proposed coral critical habitat.

5. Application of ESA Section 4(b)(2)

Section 4(b)(2) of the ESA requires that we consider the economic impact, impact on national security, and any other relevant impact, of designating any particular area as critical habitat. Additionally, the Secretary has the discretion to consider excluding any area from critical habitat if he or she determines that the benefits of exclusion (that is, avoiding some or all of the impacts that would result from designation) outweigh the benefits of designation based upon the best scientific and commercial data available. The Secretary may not exclude an area from designation if exclusion will result in the extinction of the species. Because the authority to exclude is discretionary, exclusion is not required for any particular area under any circumstances.

The ESA provides the USFWS and NMFS (the Services) with broad discretion in how to consider impacts. (See, H.R. Rep. No. 95-1625, at 17, reprinted in 1978 U.S.C.C.A.N. 9453, 9467 (1978). "Economics and any other relevant impact shall be considered by the Secretary in setting the limits of critical habitat for such a species. The Secretary is not required to give economics or any other "relevant impact" predominant consideration in his specification of critical habitat...The consideration and weight given to any impact is completely within the Secretary's discretion."). Courts have noted the ESA does not contain requirements for any particular methods or approaches (See, e.g., Bldg. Indus. Ass'n of the Bay Area et al. v. U.S. Dept. of Commerce et al., 792 F.3d 1027 (9th Cir. 2015) [upholding district court's ruling that the ESA does not require the agency to follow a specific methodology when designating critical habitat under section 4(b)(2)]). Guidance for 4(b)(2) analyses is provided in our 2016 policy (81 FR 7226, February 11, 2016) and regulations at 50 CFR 424, which was utilized in the following analyses.

The following sub-sections describe the economic, national security, and other relevant impacts that we projected would result from including the specific areas described above in the coral critical habitat designation. We considered these impacts when deciding whether to exercise our discretion to exclude particular areas from the designation. Both positive and negative impacts were identified and considered (these terms are used interchangeably with benefits and costs, respectively). Impacts were evaluated in quantitative terms where feasible, but qualitative appraisals were used where that is more appropriate.

The primary impacts of a critical habitat designation result from the ESA section 7(a)(2) requirement that Federal agencies ensure that their actions are not likely to result in the destruction or adverse modification of critical habitat, and that they consult with NMFS in fulfilling this requirement. Determining these impacts is complicated by the fact that section 7(a)(2) also requires that Federal agencies ensure their actions are not likely to jeopardize the species' continued existence, because the listing of corals under the ESA in 2014 already requires federal agencies to avoid jeopardizing the listed species. Thus, the impacts of coral critical habitat are only those that would be in addition to the impacts of listing – these additional impacts of critical habitat are referred to as "incremental impacts". That is, the incremental impacts described in this 4(b)(2) analysis are those not expected to occur in the absence of coral critical habitat.

As noted in section 3.4.17 above, the distributions of listed corals within critical habitat strongly influences the extent of incremental impacts. The more coral critical habitat without colonies of listed corals, the higher the proportion of federal actions that would affect critical habitat but not listed corals, and thus the higher the incremental impacts of critical habitat. Conversely, if colonies of listed corals were distributed throughout coral critical habitat, there would be a lower proportion of federal actions that would affect critical habitat but not listed corals, and thus the lower the incremental impacts of critical habitat. As described in more detail in section 3.4.17, listed corals are generally distributed throughout the specific areas being considered for proposed critical habitat. Thus, we believe that the incremental impacts of proposed coral critical habitat are quite low.

One incremental impact of designation is the extent to which Federal agencies modify their proposed actions to ensure that they are not likely to destroy or adversely modify the critical habitat beyond any modifications they would make because of listing and the jeopardy requirement. When the same modification would be required due to impacts to both the species and critical habitat, the impact of the designation is co-extensive with the ESA listing of the species (i.e., attributable to both the listing of the species and the designation critical habitat). To the extent possible, our analysis identified impacts that were incremental to the proposed designation of critical habitat, meaning those impacts that are over and above impacts attributable to the species' listing or any other existing regulatory protections. Relevant, existing regulatory protections (including the species' listing) are referred to as the "baseline" and are also discussed in the following sections.

The following impact analyses describe projected future federal activities that would trigger section 7 consultation requirements because they may affect the essential feature, and consequently may result in economic or national security impacts. Additionally, these analyses describe broad categories of project modifications that may reduce impacts to the essential feature, and state whether the modifications are likely to be solely a result of the critical habitat designation or co-extensive with another regulation, including the ESA listing of the species.

5.1. 4(b)(2) Economic Impacts

Economic impacts of the proposed critical habitat designation result through implementation of section 7 of the ESA in consultations with federal agencies to ensure their proposed actions are not likely to destroy or adversely modify critical habitat. These economic impacts may include both administrative and project modification costs. The economic impacts of proposed coral critical habitat are analyzed in the full 4(b)(2) Economic Impact Analysis document, completed in 2021, which is Appendix C of this report. The Economic Impact Analysis (Appendix C) projects economic impacts of coral critical habitat for the 10-year period 2022–2031, as summarized in sections 5.1.1 to 5.1.6 below from Appendix C. In addition, relevant factors that were not considered in the Economic Impact Analysis (Appendix C) are described in section 5.1.7, and a summary is provided in section 5.1.8.

5.1.1. **Introduction**

As summarized from section 1.0 of Appendix C, section 4(b)(2) of the ESA requires the NMFS to consider the economic, national security, and other relevant impacts of designating a particular area as critical habitat. NMFS has discretion to consider excluding areas from critical habitat if it determines that the economic impacts outweigh the conservations benefits of specifying an area as part of the critical habitat, unless it also determines that the failure to designate the area as critical habitat will result in the extinction of the species concerned (16 U.S.C. § 1533(b)(1)(A)).

The purpose of the economic analysis is to identify and analyze the potential economic impacts associated with the designation of critical habitat areas for the listed corals found in the waters of American Samoa, Guam, CNMI, PRIA, and NWHI. In addition, identification of these economic impacts addresses the requirements of Executive Order 12866 (as affirmed and supplemented by Executive Order 13563), which directs federal agencies to assess the costs and benefits of regulatory actions.

To estimate the economic impacts of proposed critical habitat designation, this analysis compared the extent of protections afforded the corals' habitat in the "without critical habitat" and "with critical habitat" scenarios and then estimated the incremental costs of achieving compliance under the latter. The "without critical habitat" scenario represents the baseline for the analysis, considering protections already afforded the critical habitat as a result of the listing of the corals as threatened species, or as a result of other federal, territorial, or commonwealth regulations or protections. The "with critical habitat" scenario describes the incremental impacts associated specifically with the designation of critical habitat for the listed coral species. That is, the incremental impacts described in this analysis are those not expected to occur absent the designation of critical habitat for the listed coral species.

To describe the economic impacts of proposed critical habitat designation for the listed coral species, this analysis undertakes the following general steps:

1. Assume that the areas considered for proposed coral critical habitat in 2020 will also be considered for the new proposed designation. Characterize the areas considered for proposed designation in terms of economic activities and existing management, as well as the presence of overlapping protections such as existing critical habitat designations or conservation areas.
2. Identify the types of activities that may result in the destruction or adverse modification of critical habitat and that may be subject to section 7 consultation pursuant to the ESA and forecast the expected occurrences of these activities within the boundaries of the potential proposed critical habitat.
3. Describe the suite of potential project modifications for these activities that may be recommended by NMFS through section 7 consultation to ensure they are not likely to destroy or adversely modify critical habitat.
4. Estimate the economic impacts of complying with the ESA's critical habitat provisions. These incremental costs include the direct costs associated with additional administrative effort required to conduct section 7 consultations as well as the direct costs associated with project modifications that would not have been required under the baseline scenario to avoid jeopardizing the continued existence of the species.
5. Provide information on the distribution of economic impacts across the particular areas considered for proposed designation.
6. Evaluate the potential economic benefits stemming from the incremental project modifications.

This methodology is supported by the best available data, including focused interviews of key stakeholders and information from public comments submitted during the public comment period for the 2020 proposed coral critical habitat rule (Appendix C).

5.1.2. Framework and Scope

As summarized from section 2.0 of Appendix C, this economic analysis employs "without critical habitat" and "with critical habitat" scenarios. The "without critical habitat" scenario represents the baseline for the analysis, considering protections already afforded the areas being considered for coral critical habitat. The "with critical habitat" scenario describes and, to the extent possible, monetizes the incremental impacts due specifically to designation of coral critical habitat. For the purposes of the economic impact analysis, all waters from a depth of zero to 50 meters around all islands, atolls, reefs, and banks in American Samoa, Guam, CNMI, PRIA, and FFS in NWHI were assumed to be included in proposed coral critical habitat.

For the "without critical habitat" scenario, baseline protections in American Samoa, Guam, CNMI, PRIA, and NWHI were described. These baseline protections include the listing of the species under the ESA, other federal laws, and territorial, commonwealth, and state laws. In addition to these regulations, the baseline reflects factors beyond compliance with existing regulations that provide protection to the habitat proposed to be designated as critical habitat. For example, initiatives for coral reef conservation may be relevant to addressing threats to corals and coral reefs.

For the "with critical habitat" scenario, the incremental impacts of proposed coral critical habitat are described and monetized. These incremental impacts stem from changes in the management of activities resulting from proposed designation of coral critical habitat. When critical habitat is designated, section 7 of the ESA requires federal agencies to ensure that their actions are not likely to destroy or adversely modify critical habitat, as well as ensure that the actions are not likely to jeopardize the continued existence of the species. The direct costs associated with additional administrative effort required to conduct section 7 consultations as well as the direct costs associated with project modifications that would not have been required under the baseline scenario to avoid jeopardizing the continued existence of the species constitute the direct compliance costs of designating critical habitat.

The economic analysis estimates economic impacts over the 10-year period 2022 to 2031, including estimation of annual impacts. The methodology for translating future economic impacts to present value is described in section 3.4 of Appendix C (the calculation of present value and annualized impacts requires application of the formulas and discount rate shown in Equation 1). Application of a seven percent “discount rate” is part of the methodology, thus the discount rate is referenced in the following summaries of the results of Appendix C.

To address uncertainty, this economic analysis represents a range of potential economic impacts by using “low-end” and “high-end” scenarios to estimate incremental impacts: (1) The low-end scenario is based on the assumption that the relative proportions of informal and formal section 7 consultations over the next 10 years will be similar to the relative proportions of informal and formal consultations collected from PIRO’s section 7 consultation database (i.e., that coral critical habitat will not result in a higher proportion of formal consultations than in the past); and (2) the high-end scenario is based on the assumption that all section 7 consultations over the next 10 years will be formal (i.e., that coral critical habitat will result in a much higher proportion of formal consultations than in the past, which typically result in some project modifications; Appendix C).

As summarized from section 3.0 of Appendix C, the scope of the economic analysis refers to the different types of incremental impacts resulting from proposed coral critical habitat, including direct and indirect costs, as well as any incremental benefits that may stem from the rulemaking. Direct costs refer to direct incremental impacts of critical habitat designation, including: (1) the additional administrative costs of considering the potential for adverse effects to critical habitat during section 7 consultations; and (2) implementation of any project modifications recommended by NMFS through section 7 consultation to avoid potential destruction or adverse modification of critical habitat. Indirect costs refer to effects on actions that do not have a federal nexus and thus are not subject to the provisions of section 7 of the ESA, such as delays in non-federal actions (Appendix C).

5.1.3. Activities that May be Affected

As summarized from section 4.0 of Appendix C, identification of activities that action agencies believe may affect listed coral species drew upon historical consultation records from 2005 through 2020 within areas of overlap with the listed corals. Based on the records, the following list of the categories of activities that may adversely affect the essential features of the critical habitat and involve a federal nexus was developed:

- In-water & Coastal Construction: Construction and maintenance of roads, bridges, or culverts; installation and maintenance of wharfs, docks, and pilings; placement of buoys, moorings, anchorages, and navigation aids; boat ramp construction or maintenance; shoreline protection (revetments, seawalls, breakwaters, jetties, excavation, fill, etc.); and construction or repair of submarine pipelines and cables.
- Dredging and Disposal: Dredging harbors and navigable waterways, as well as the disposal of dredged material.
- Water Quality and Discharges: Issuance of National Pollutant Discharge Elimination System (NPDES) permits and review of water quality standards; pesticide regulation; activities that release heavy metals, hydrocarbons, pesticides, organic compounds, and other contaminants into the marine environment.
- Fishery Management: Development of management measures in federally managed commercial and recreational fisheries.
- Military Activities: In-water military training exercises.
- Shipwreck and Marine Debris Removal: Shipwreck response and removal and marine debris removal.
- Scientific Research & Monitoring: Issuance of permits for marine-related research and monitoring projects.
- Aquaculture: Coastal and offshore facilities used for the culture of organisms for commercial, subsistence, or research purposes.
- Protected Area Management: Management of national parks, national marine sanctuaries, and federal wildlife refuges.
- Beach Nourishment/Shoreline Protection: Placement of sand onto eroding beaches from onshore or offshore borrow sites.

Table 4 summarizes historical section 7 consultation activity for each of these activity categories from 2005 through 2020. Informal consultations accounted for the largest share (approximately 41 percent) of historical consultations occurring within the critical habitat. The limited subset of formal consultations (19 actions) was primarily associated with in-water and coastal construction activities (8 actions) and scientific research & monitoring (6 actions), with a relatively small number of actions associated with dredging and disposal, fishery management, and aquaculture. Approximately 35 percent of the consultations involved activities authorized under Pac-SLOPES and the PMNM programmatic, and 19 percent were technical assists.

Table 4. NMFS Pacific Islands Region section 7 Consultations in Areas Considered for Proposed Critical Habitat by Activity and Consultation Type, 2005 – 2020 (from Table 1 in Appendix C).

Activity Category	Number of Formal Consultations	Number of Informal Consultations	Number of Programmatic Consultations	Number of Technical Assists	Total
In-water & Coastal Construction	8.0	91.9	54.0	55.0	208.9
Dredging and Disposal	2.0	7.4	3.5	8.0	20.9
Water Quality and Discharges	0.0	10.4	1.0	10.0	21.4
Fishery Management	2.0	3.5	0.0	0.0	5.5
Military Activities	0.0	1.0	0.0	1.0	2.0
Shipwreck and Marine Debris Removal	0.0	15.4	9.5	4.0	28.9
Scientific Research & Monitoring	6.0	42.4	46.0	4.0	98.4
Aquaculture	1.0	1.0	6.0	0.0	8.0
Protected Area Management	0.0	0.0	30.0	0.0	30.0
Beach Nourishment/ Shoreline Protection	0.0	0.0	0.0	0.0	0.0
Total	19.0	173.0	150.0	82.0	424.0
Fractions of consultations occurred as a result of assigning some consultations to two or more activity categories.					

The largest share of consultations (43 percent) occurred in Guam. American Samoa, CNMI, and the NWHI each accounted for approximately 18 percent of the consultations, while the PRIA accounted for 3 percent (see Table 2 in Appendix C). This analysis considered each of the five U.S. jurisdictions as a whole. However, the activities that resulted in section 7 consultations were not evenly distributed within a given jurisdiction. Rather, with the exception of the unpopulated French Fr qigate Shoals in NWHI, the majority of historical consultations were concentrated in regions that are heavily populated. In American Samoa the activities that resulted in section 7 consultations occurred mainly on Tutuila; in CNMI they occurred mainly on Saipan; and in Guam they occurred mainly in the region around Hagåtña (Appendix C).

5.1.4. Projections of Future Section 7 Consultations

As summarized from section 5.0 of Appendix C, we forecast that approximately 288 section 7 consultations are likely to consider the listed corals' critical habitat over the 2022–2031 period. To forecast the location of future consultations, we identified the proposed critical habitat area associated with each historical consultation. We then projected the future number of consultations expected to occur in each proposed critical habitat area based on the consultation history. Table 5 displays the expected number of future consultations from 2022 through 2031 by jurisdiction and consultation type. The largest share of consultations (44 percent) is expected to occur in Guam, followed by CNMI (19 percent), American Samoa and NWHI (17 percent each), and the PRIA (2 percent). Programmatic (40 percent) and informal (38 percent) consultations are projected to account for the large majority of consultations.

Table 5. Projected Number of section 7 Consultations in Areas Considered for Proposed Critical Habitat by Jurisdiction and Consultation Type, 2022–2031 (from Table 13 in Appendix C).

Jurisdiction	Number of Formal Consultations	Number of Informal Consultations	Number of Programmatic Consultations	Number of Technical Assists	Total
American Samoa	6.3	29.4	8.2	6.4	50.3
Guam	3.5	46.6	42.7	34.5	127.3
CNMI	1.6	22.8	21.8	9.2	55.5
NWHI	0.0	3.4	43.8	0.3	47.5
PRIA	0.5	5.9	0.0	0.8	7.2
Total	11.9	108.1	116.5	51.3	287.7
Fractions of consultations occurred as a result of assigning some consultations to two or more activity categories and/or jurisdictions.					

Based on the historical consultations, the economic analysis anticipates that consultations related to in-water and coastal construction will constitute just over half of consultations over the 2022–2031 period. This equates to an annual predicted average of about 14 consultations per year in this category. Scientific research and monitoring is expected to account for 22 percent of consultations. Consultations related to shipwreck and marine debris removal and protected area management are each expected to account for 7 percent of consultations, with consultations related to water quality and discharges, dredging and disposal, aquaculture, fishery management, and military activities each representing 5 percent or less of consultations. (Appendix C).

5.1.5. Estimated Incremental Impacts

As summarized from section 6.0 of Appendix C, the focus of the economic analysis is to estimate the incremental impacts due specifically to designation of critical habitat for the listed corals. The incremental impacts stem from changes in the management of activities, above and beyond those changes resulting from existing required or voluntary conservation efforts undertaken due to other federal and other regulations or guidelines.

The analysis considers both direct and indirect impacts of critical habitat designation. Direct impacts include the costs associated with additional administrative effort required to conduct section 7 consultations, as well as the direct costs associated with project modifications that would not have been required in the absence of coral critical habitat. Total incremental costs are estimated by adding these two types of costs. Indirect impacts are those changes in economic behavior that may occur due to critical habitat designation for reasons other than direct ESA requirements, such as time delays, regulatory uncertainty, and stigma effects. The uncertainties used in the economic analysis are also summarized below. As noted in section 5.1.2 above, the economic analysis provides low-end and high-end cost estimates.

To calculate present value and annualized impacts, guidance provided by OMB specifies the use of a real annual discount rate of seven percent (U.S. Office of Management and Budget 2003). In addition, OMB recommends sensitivity analysis using other discount rates, such as three percent, which some economists believe better reflects the social rate of time preference (i.e., the willingness of society to exchange the consumption of goods and services now for the consumption of goods and services in the future). Accordingly, the economic analysis presents results applying a seven percent discount rate, together with a sensitivity analysis in Appendix C(1) that presents impacts assuming a discount rate of three percent (Appendix C).

As summarized from section 6.1 of Appendix C and shown in Table 6, under the low-end scenario, incremental administrative costs of critical habitat designation are estimated at $373,171 from 2022 through 2031 (discounted at seven percent), with an annualized cost of $53,131. Under the high-end scenario, incremental administrative costs are expected to total $612,159 from 2022 through 2031 (discounted at seven percent), with an annualized cost of $87,158 (Appendix C).

Table 6. Low-End and High-End Estimated Incremental Administrative Costs for Activities in Areas Considered for Proposed Coral Critical Habitat by Jurisdiction, 2022–2031 ($2021; 7% Discount Rate, from Table 16 in Appendix C).

Jurisdiction	Present Value Impacts (Seven Percent Discount Rate)	Annualized Impacts
Low-End		
American Samoa	$92,468	$13,165
Guam	$151,749	$21,606
CNMI	$72,244	$10,286
NWHI	$42,899	$6,108
PRIA	$13,810	$1,966
Total	$373,171	$53,131
High-End		
American Samoa	$157,396	$22,410
Guam	$254,666	$36,259
CNMI	$122,666	$17,465
NWHI	$50,497	$7,190
PRIA	$26,934	$3,835
Total	$612,159	$87,158

As summarized from section 6.2 of Appendix C, under the low-end scenario, incremental project modification costs are zero, and the incremental effects of critical habitat designation are limited to additional section 7 administrative costs. The high-end incremental project modification costs are presented in Table 7. While per project modification costs would vary significantly depending on the location and nature of the project, this analysis used the maximum cost estimates to calculate total incremental costs in order to be consistent with the conservative approach of the high-end scenario. As shown in Table 7, the high-end incremental project modification costs are estimated at $6.2 million, discounted at seven percent, from 2022 through 2031, with an annualized cost of $883,267. Approximately 53 percent of the estimated high-end project modification costs would occur in Guam (Appendix C).

Table 7. High-End Estimated Incremental Project Modification Costs for Activities in Areas Considered for Proposed Critical Habitat Areas by Jurisdiction, 2022–2031 ($2021, 7% Discount Rate, from Table 22 in Appendix C).

Jurisdiction	Present Value Impacts (Seven Percent Discount Rate)	Annualized Impacts
American Samoa	$1,773,584	$252,519
Guam	$3,273,363	$466,053
CNMI	$1,031,661	$146,885
NWHI	$56,974	$8,112
PRIA	$68,118	$9,699
Total	$6,203,701	$883,267

As summarized from section 6.3 of Appendix C, total incremental costs (i.e., administrative + project modification costs) are shown in Table 8 for the low-end and the high-end scenarios, split out by jurisdiction. For the low-end, total incremental costs over the 10-year period 2022-2031 are estimated at $373,171 (discounted at seven percent), which translates to an annualized cost of $53,131. For the high-end, total incremental costs over the 10-year period 2022-2031 are estimated at $6,815,860 (discounted at seven percent), which translates to an annualized cost of $970,425 (Table 8). Nearly 95 percent of total high-end incremental costs result from project modifications assumed to be required in the high-end impact scenario. As illustrated in Table 8, the jurisdiction with the greatest costs is Guam, due to the high number of expected section 7 consultations in this area (Appendix C).

Table 8. Low-End and High-End Estimated Total Incremental Costs (Administrative and Project Modification) for Activities in Areas Considered for Proposed Critical Habitat by Jurisdiction, 2022–2031 ($2021, 7% Discount Rate, from Table 23 in Appendix C).

Jurisdiction	Present Value Impacts	Annualized Impacts
Low-End		
American Samoa	$92,468	$13,165
Guam	$151,749	$21,606
CNMI	$72,244	$10,286
NWHI	$42,899	$6,108
PRIA	$13,810	$1,966
Total	$373,171	$53,131
High-End		
American Samoa	$1,930,980	$274,928
Guam	$3,528,029	$502,312
CNMI	$1,154,328	$164,350
NWHI	$107,471	$15,302
PRIA	$95,052	$13,533
Total	$6,815,860	$970,425

As summarized from section 6.4 of Appendix C, project proponents may incur indirect costs of critical habitat designation, including project delays attributable to increased duration of project reviews. For example, hotels may be discouraged from locating in Guam and CNMI due to the length of time that may be required to add an amenity such as a dock. However, forecasting the costs associated with the regulatory uncertainty and potential project delays resulting from the designation of critical habitat for the listed coral species is too speculative to be quantified in this analysis. Moreover, for most projects, delays attributable to the additional time to consider the listed corals' critical habitat as part of future section 7 consultation are expected to be minor, given that most projects would already have to consider jeopardy concerns with respect to the listed coral species and other listed species (Appendix C).

As summarized from section 6.5 of Appendix C, several uncertainties underlie the calculation of incremental costs that could result from the designation of critical habitat for the listed coral species. These uncertainties, and their particular significance with respect to the results of this analysis, are summarized in Table 9. Additional uncertainties not considered in the economic analysis are described in section 5.1.7 below.

Table 9. Summary of Uncertainties (from Table 26 in Appendix C).

Assumption/Source of Uncertainty	Direction of Potential Bias	Likely Significance with Respect to Estimated Impacts
This analysis relies on patterns of section 7 consultations from 2005 through 2020 to forecast future rates and locations of consultation activity. The analysis assumes that past consultation rates provide a good indication of future activity levels and distribution of activities.	Unknown. May underestimate or over-estimate incremental impacts.	Data are not available to determine whether the rates or locations of activities subject to consultation are likely to change over time. To the extent that activities increase from 2022 through 2031, our analysis may underestimate or overestimate incremental costs.
The analysis assumes no new consultations will be triggered by the designation of critical habitat for the listed coral species.	May underestimate incremental impacts.	Likely minor. Consultations which cover activities occurring in areas where listed species are not present are unlikely. However, to the extent that any future section 7 consultations occur solely due to critical habitat designation, incremental impacts will be underestimated.
This analysis assumes that inclusion of a critical habitat destruction/ adverse modification analysis in future consultations, in addition to the jeopardy analysis, will always result in additional administrative cost and effort.	May overestimate costs.	Likely minor. While the critical habitat rule may provide additional information that assists in the analysis of effects under both the jeopardy and the destruction/adverse modification standard, each consultation will still need to include both jeopardy and critical habitat destruction/adverse modification analyses. To the extent that new information in the critical habitat rule provides justification for effects analysis, administrative costs may be overstated.
It is uncertain if critical habitat designation for the listed coral species would result in all future consultations being formal.	Range of results captures this uncertainty.	To address this uncertainty, the analysis presents a range of incremental administrative costs. At the low end, assuming past informal consultation rates provide a good indication of future rates may understate impacts. At the high end, assuming all future consultations will be formal may overstate impacts.
It is uncertain if baseline protections (e.g., typical USACE permit conditions or project modifications recommended due to presence of listed coral species) provide sufficient protection to avoid destruction or adverse modification of critical habitat or are consistently applied to all projects within proposed critical habitat.	Range of results captures this uncertainty.	To address this uncertainty, the analysis presents a range of incremental project modification costs. At the low end, assuming none of the projects require additional project modifications may understate impacts. At the high end, assuming baseline protections are not sufficient and additional project modifications are required for certain categories of activities may overstate impacts.

Assumption/Source of Uncertainty	Direction of Potential Bias	Likely Significance with Respect to Estimated Impacts
This analysis does not quantify potential indirect impacts associated with time delays.	May result in an under-estimate of costs.	Likely minor. For new projects, action agencies will be required to consult with NMFS due to the presence of the listed coral species or other listed species or critical habitat. Therefore, the indirect incremental impact associated with time delay on new projects would be limited to any costs incurred specifically during the additional time necessary to complete the analysis of destruction/adverse modification of the proposed critical habitat. Time delays would be expected to remain largely unchanged regardless of the proposed critical habitat designation. It is also important to note that the ESA requires a biological opinion be submitted to the federal action agency within 135 days of initiating formal consultation. This requirement may help reduce time delays. At the high end, this analysis assumed that all future consultations will be formal.

5.1.6. Economic Benefits

As summarized from section 7.0 of Appendix C, those physical and biological features essential to the conservation of the listed coral species are also essential to the conservation of most other coral reef species in American Samoa, Guam, CNMI, NWHI, and the PRIA. Thus, implementation of project modifications undertaken to avoid destruction and adverse modification of the critical habitat of the listed corals would provide better protection of corals and coral reef ecosystems as a whole in the designated critical habitat areas. This section summarizes the economic benefits of coral reef ecosystems in the critical habitat areas, and the potential contribution of critical habitat designation to the realization of those benefits.

The NOAA Coral Reef Conservation Program (CRCP) summarized existing economic valuation studies focused on values of U.S. coral reefs in a 2013 literature review and synthesis (Brander and van Beukering 2013, NOAA CRCP 2013). These economic valuation studies provide insight into why healthy coral reefs benefit people. In particular, coral reefs are associated with the following ecosystem service benefits: (1) Provide essential habitat and nursery functions for recreationally and commercially valuable fish species; (2) increased quality or quantity of reef-related recreational opportunities; (3) shoreline protection; (4) education and research; and (5) amenity values (e.g., the presence a coral reef can have a positive effect on home prices (Brander and van Beukering 2013). The estimated total value in 2021 dollars of these coral reef ecosystem services is $13.4 million per year in American Samoa, $165.0 million per year in Guam, and $60.4 million per year in CNMI (Section 7.1, Appendix C).

By furthering the conservation of the listed coral species, critical habitat designation would likely contribute to the realization of the above types of coral reef ecosystem services across the critical habitat areas. Taylor et al. (2005) found that listed species with designated critical habitat are more than twice as likely to move toward recovery than species without designated critical habitat. However, determining the incremental effect of critical habitat on coral species conservation and recovery is complicated. Such an evaluation would require the ability to isolate and quantify the effect of the designated critical habitat separately from all other ongoing or planned conservation efforts for these coral species in particular, and coral reef ecosystems in the proposed critical habitat areas in general. A major limitation with respect to predicting the incremental effect of the designation on the conservation and recovery of the species is the uncertainty regarding whether and where the designation may generate changes in the way projects are managed (i.e., project modifications) to avoid destruction or adverse modification of critical habitat. In most cases, critical habitat designation is not expected to change how a project or activity is implemented, as the listing status of the listed coral species and other baseline protections already affords these areas significant protections.

In some instances, however, NMFS may determine that a project or activity may adversely modify critical habitat and recommend additional conservation beyond what would be recommended to avoid jeopardy or take of the species. Some of these consultations may result in recommendations for additional project modifications. Specifically, certain USACE-permitted activities, including in-water and coastal construction and dredging and disposal, may be subject to additional project modification recommendations explicitly to avoid destruction or adverse modification of critical habitat. Given that these activities account for the majority of expected future consultations, designation of critical habitat for the listed coral species may contribute to the realization of coral reef related ecosystem services across the proposed critical habitat areas. However, such benefits cannot be quantified given the high level of uncertainty about whether these incremental project modifications would be required, and if they are required, the extent of such benefits (Appendix C). Potential benefits of coral critical habitat are further described qualitatively in section 5.3.1 below.

5.1.7. **Additional Uncertainties**

The Summary of Uncertainties (Table 9) in section 5.1.5 above describes the key uncertainties in the economic analysis. Here additional uncertainties are described, including: (1) Concerns raised in September 2021 by the Governments of Guam and CNMI during Coastal Zone Management Act discussions that the methodology is more likely to result in underestimation of economic impacts than acknowledged in the analysis; and (2) that the areas assumed by the economic analysis to be included in proposed coral critical habitat likely result in overestimation of economic impacts in the analysis. These two considerations are described below.

<u>Methodology could underestimate economic impacts</u>. After the public comment period for proposed coral critical habitat, Guam and CNMI argued that the economic impact analysis methodology of using historical section 7 consultations to project future consultations substantially underestimates the number of future critical habitat consultations, thereby underestimating likely economic impacts of critical habitat. To support their arguments, Guam and CNMI provided information in September 2021 showing that the numbers of certain types of federal actions in past years were much higher than the numbers of consultations projected for those years in the economic analysis that was done for the 2020 proposed rule.

As noted in the Summary of Uncertainties (Table 9) in section 5.1.5 above, the methodology of using historical consultations to estimate future consultations may result in either underestimates or overestimates of future consultations and thus economic impacts, but also that it is not possible to determine the direction of potential bias. The Governments of Guam and CNMI disagreed, arguing that the direction of potential bias is more likely to underestimate future economic impacts. They supported their arguments by providing information showing that in 2018 and 2019, there were much larger numbers of federal actions in Guam and CNMI that they believe would result in new section 7 consultations on coral critical habitat than projected for those years in the economic analysis that was done for the 2020 proposed rule (Edwin Reyes, Guam Coastal Management Program Administrator, and Arthur Charfauros, CNMI Coastal Resources Planner, pers. comm, Sep-21). That is, they argued that a much higher proportion of such federal actions would require consultation on proposed coral critical habitat than estimated by the economic analysis in the 2020 proposed rule (the same methodology was used for the economic analyses in the 2020 proposed rule and the new proposed rule).

Guam's and CNMI's arguments depend on the notion that the incremental impacts of coral critical habitat were underestimated in the 2020 proposed rule and its economic analysis, which was a position taken in both Guam's and CNMI's public comment letters (Guam DOAG 2021, CNMI DLNR 2021). However, as explained in section 3.4.17 above, the information on the distributions of listed corals (see Appendix A) show that they are generally distributed around Guam, Saipan, and the other islands of proposed coral critical habitat, within the specific areas being considered for proposed coral critical habitat described in section 3.4 above. The wide distributions of listed corals within the areas being considered for proposed coral critical habitat limit the incremental impacts of critical habitat, thus we do not agree that the economic analysis is more likely to underestimate economic impacts than overestimate them. In fact, the narrower delineation of proposed coral critical habitat than in the 2020 proposed rule is more likely to result in the economic analysis overestimating economic impacts, as explained in the following two paragraphs.

While we do not believe that our methodology underestimates the economic impacts of coral critical habitat, the information provided in September 2021 by Guam's and CNMI's Coastal Zone Management (CZM) Programs improves our understanding of their concerns regarding the potential impacts of coral critical habitat. That information, together with this revised report including the Economic Impact Analysis (Appendix C), provide the background and context needed to facilitate our forthcoming discussions with Guam's and CNMI's CZM Programs on the CZMA determinations needed for the final rule.

<u>Assumed areas of critical habitat likely overestimate economic impacts</u>. As noted in section 5.1.2 above, all waters from 0-50 m of depth around all islands (including all atolls, reefs, and banks) in American Samoa, Guam, CNMI, PRIA, and FFS in NWHI were assumed to be included in proposed coral critical habitat for the economic analysis. However, the actual areas included in proposed coral critical habitat are substantially smaller than that because: (1) As described in Appendix A, not all of the islands within these jurisdictions are included in proposed coral critical habitat; (2) as described in section 3.1 and shown in Table 2 above, the depth ranges of proposed coral critical habitat will be less than 0 – 50 m on 17 of the 18 islands of proposed coral critical habitat; (3) as described in section 3.2, artificial substrates and "managed areas" (i.e., harbors, navigation channels, marinas, etc.) are not included in critical habitat; (4) as described in section 3.4 above, within the depth ranges considered for proposed coral critical habitat, no areas of soft substrate (e.g., sand, mud, rubble) are included; and (5) as also described in section 3.4 above, many nearshore areas of hard substrates are unsuitable (e.g., many reef flats), and thus are not included in proposed coral critical habitat.

As explained in section 2.2 of Appendix C, the approach of assuming the maximum possible areas for proposed coral critical habitat in the economic analysis was intentionally used in order to portray an economic "worst-case" scenario. However, the effect of doing so likely overestimated actual economic impacts more than expected, because the extent of proposed coral critical habitat was reduced for several different reasons (i.e., the five reasons described in the above paragraph), not all of which were anticipated at the beginning of the economic analysis. This is especially true because the different reasons collectively removed many areas where future federal actions that could affect the essential feature would be located (i.e., managed areas, nearshore areas of soft substrates, and nearshore areas of unsuitable hard substrates). This consideration is not included in the Summary of Uncertainties (Table 9) in section 5.1.5 above.

5.1.8. Economic Impacts Summary

In summary, the economic impacts of proposed coral critical habitat are estimated in Appendix C in terms of low-end and high-end scenarios. For the low-end, total incremental costs over the 10-year period 2022-2031 are estimated at $373,171 for all jurisdictions combined, or $53,131 annualized.

These are 100 percent administrative costs, since the low-end scenario assumes that no project modifications will be required. For the high-end, total incremental costs over the 10-year period 2022-2031 are estimated at $6,815,860 for all jurisdictions combined, or $970,425 annualized. Of these costs, 95 percent are derived from project modifications, since the high-end scenario assumes that 100 percent of section 7 consultations will be formal. The jurisdiction with the highest economic impacts in both scenarios is Guam, due to the relatively high number of expected consultations there (Appendix C).

While the two scenarios are useful for illustrating the range of potential economic impacts, the following facts should be kept in mind when interpreting their results:

1. Both scenarios assumed that proposed coral critical habitat would be unrealistically expansive (i.e., all waters 0 – 50 m depth around all 20 island units considered in proposed and proposed coral critical habitat), which means that both scenarios are overestimates.
2. As explained in section 3.4.19 and the Introduction to section 5 above, listed corals are generally distributed throughout the specific areas being considered for proposed coral critical habitat. Since proposed coral critical habitat will not include extensive areas where listed coral colonies are absent, the incremental impacts of proposed coral critical habitat are likely to be quite low, which minimizes economic impacts.
3. A comparison of projected vs. actual consultations in 2016-2019 was included in the economic analysis done for the proposed coral critical habitat rule (NMFS 2020a, Appendix B), which showed that three times more formal consultations were projected in the high-end scenario than actually occurred. That is, the reality of consultations was more similar to the low-end scenario than the high-end scenario.

For these reasons, we believe that the actual economic impacts are likely to be much closer to the low-end scenario's projections than the high-end scenario's projections. In addition, as noted in section 5.1.6 above, economic benefits would be relatively high in the high-end scenario (because project modifications would provide better protection of coral reef ecosystems, which produce economic benefits), but non-existent in the low-end scenario (because there would be no project modifications, and thus no increased protection of coral reef ecosystems). We conclude that the economic impacts of proposed coral critical habitat are likely to be much closer to those projected by the low-end scenario than the high-end scenario, and also that there would be low economic benefits. That is, we believe that the economic analysis supports the conclusion that proposed coral critical habitat would have low economic effects.

5.2. 4(b)(2) National Security Impacts

The national security impacts of proposed coral critical habitat are analyzed below. These impacts were analyzed based on information provided by DOD/Navy (DON 2015, 2019b) and Department of Homeland Security (DHS)/Coast Guard (USCG 2015, 2016) to NMFS for the proposed coral critical habitat rule, and updates provided via email by DON and USCG in 2021. Outside of the JRM and Wake INRMP marine areas described in the 4(a)(3) section above, four sites were requested for exclusion by DOD and USCG from proposed coral critical habitat based on national security impacts, one in Guam and three in CNMI: The marine component of the Navy's overlapping surface danger zones off of Ritidian Point (hereafter referred to as Ritidian Point Surface Danger Zone complex) on Guam, 2 USCG anchorages on Tinian, and a system of 12 Navy anchorage berths on Saipan. However, only the Navy's Ritidian Point Surface Danger Zone complex is requested for exclusion from proposed coral critical habitat, as explained in section 5.2.1. The USCG anchorages on Tinian, and the Navy berths on Saipan, are no longer requested for exclusion, as explained in section 5.2.2.

Impacts to national security may arise when DOD or USCG actions at a site are required for national security and are likely to result in adverse modification or destruction of the essential feature, therefore section 7 consultation requirements may cause significant delays in or modifications to the activity, potentially impacting national security. In most cases, consultation under section 7 will already be required because of the listing itself, so consultation for critical habitat would add an additional layer of consultation rather than an entirely new consultation effort on its own. If additional consultation requirements are likely due to critical habitat at a site, then consideration of other factors is needed to characterize subsequent impacts to national security, such as the type and frequency of additional consultation, potential delays and requirements resulting from the additional consultation, and how unique the DOD activities are at the site.

Benefits to the conservation of listed corals depends on whether designation of critical habitat at a site leads to additional conservation of the species above what is already provided by being listed under the ESA in the first place. The potential for additional conservation is a function of many factors, including at least the quantity and quality of essential feature at the site, the level of protection of the essential feature already provided by existing management of the site, the likelihood of other Federal (non-DOD) actions being proposed within the site that would be subject to critical habitat; and whether critical habitat helps address the unique conservation challenges associated with listed corals.

Based on the information below, for each site we qualitatively compare the national security impacts to the conservation benefits to determine which is greater. If national security impacts outweigh conservation benefits, the site is excluded from proposed critical habitat. If conservation benefits outweigh national security impacts, the site is not excluded from proposed critical habitat. The decision to exclude any sites from a designation of critical habitat is always at the discretion of NMFS. In no circumstances is an exclusion of any site required by our final policy on 4(b)(2) of the ESA (81 FR 7226, February 11, 2016) and regulations.

5.2.1. Guam: One Requested Site

The Guam Unit of proposed coral critical habitat includes one Navy 4(b)(2) national security site that was requested for exclusion: The Ritidian Point Surface Danger Zone (SDZ) complex (see Fig. 21 in NMFS 2020a) overlaps with a small area of forereef being considered for proposed coral critical habitat. The area is 0 – 12 m of depth and consists primarily of spur-and-groove and aggregate reef that provides high quality coral habitat (Burdick 2005, DON 2019a). A recent species-level coral survey conducted at this site indicated that *A. globiceps* was present: Kawahigashi et al. (2021) found a total of four colonies of *A. globiceps* (all at 6 m depth) along eight 50 m long transects within forereef habitat at the site. In contrast, a species-level coral survey by Donaldson and Rongo (2006) at the site did not find any *A. globiceps* colonies along eight 50 m long transects at various depths between 1 and 20 m within forereef and reef flat habitat.

National Security Impacts: National security impacts depend on the additional section 7 requirements that would result from the coral critical habitat, above and beyond those already required to avoid jeopardizing the continued existence of any listed species or avoid destruction or adverse modification of other, designated critical habitats (i.e., incremental impacts). The Navy noted that the Ritidian Point SDZ complex supports training at the Marine Corps Live Fire Training Range Complex (LFTRC) at AAFB, and construction of new facilities (e.g., range administration building, range maintenance building, observation towers) at AAFB, to meet the individual weapons training/qualification requirements of the Marine Corps. This SDZ is expected to be operational for 32 weeks per year and extends approximately 2 miles over open water in the event stray bullets go over the berm and into the ocean. If this occurs, the bullets will settle on the seafloor (DON 2015, 2019a,b).

The Type and Frequency of Additional Consultation: The Navy stated that designation of the marine component of this site as coral critical habitat would result in limitations on live fire training at

LFTRC. The Navy explained that this is because limited staff time and resources would be diverted to preparing additional documents required to implement activities in critical habitat areas from work required on other vital environmental items (DON 2015). In 2021 and 2022, the Navy confirmed that this information is still applicable to the site (J. Rivers, pers. comm., Oct-21 and Apr-22). Because many training and construction activities are planned at LFTRC adjacent to this marine area, the listed coral *A. globiceps* occurs there, and the planned activities have the potential to affect this listed species, ESA section 7 consultations would likely be necessary whether critical habitat is designated or not. That is, the additional consultation requirement above and beyond what would already be required by the fact that listed corals occur at the site is not expected to be substantial. Also, the additional consultation for critical habitat would be for activities that are planned in advance, and thus the additional section 7 coral consultation workload would not be unpredictable but rather could be anticipated and managed ahead of time.

<u>Uniqueness of DOD Activities at the Site</u>: The Navy noted that the LFTRC on Guam provides critical individual live fire training requirements for Marine Corps personnel, which is a prerequisite for conducting unit level and combined level training. Without the qualification of these live fire training events, individuals and small teams are not capable of conducting larger unit collective events. The LFTRC provides the necessary foundation for which training progression is built upon. Plans are in place to considerably expand LFTRC in anticipation of growing Marine Corps training needs. No other facility on Guam or elsewhere in the Mariana Islands provides this type of training (DON 2015, 2019a,b). In 2021 and 2022, the Navy confirmed that this information is still applicable to the site (J. Rivers, pers. comm., Oct-21 and Apr-22). If the additional section 7 requirements that would result from the coral critical habitat were likely to be substantial and unpredictable, then national security impacts would be compounded by the uniqueness of DOD activities at the site. However, as explained above, the additional section 7 requirements would be neither substantial nor unpredictable, thus the uniqueness of DOD activities does not affect the national security impacts.

Conservation Benefits: Benefits to the conservation of ESA-listed corals depend on whether designation of critical habitat at a site leads to additional conservation of the species above what is already provided by the species' listing. The potential for additional conservation at the site is a function of listed corals' use of the area, the level of protection already provided by management, and the likelihood of non-DOD actions subject to critical habitat.

<u>Listed Corals' Use of the Area</u>: As elsewhere on Guam, the coral reef habitat within the area being considered for proposed coral critical habitat is made up of forereef from 0 – 12 m depth, consisting primarily of spur-and-groove and aggregate reef (Burdick 2005, DON 2019a). The area has low human impacts and provides some of the higher quality coral reef habitat on Guam (USFWS 2009, Donaldson and Rongo 2006, Kawahigashi et al. 2021). As noted above, *A. globiceps* occurs at this site. However, colonies of the species may die off in response to natural disturbances and not reappear for a few years, which may be why Kawahigashi et al. (2021) found *A. globiceps* there but Donaldson and Rongo (2006) did not. Such mortality and recovery of coral populations at any given site is a normal response to natural disturbance (Birkeland et al. 2021).

<u>Level of Protection Already Provided by Management</u>: This site is entirely within U.S. Fish and Wildlife Service (USFWS) Submerged Lands, which forms the marine component of the Guam National Wildlife Refuge (NWR) and is managed according to the Guam NWR Comprehensive Conservation Plan (USFWS 2009). The plan includes Strategies to Restore, Protect, and Native Marine Communities, such as marine debris removal and area closures (USFWS, 2009). The site is entirely within Essential Fish Habitat (EFH) for coral reef ecosystems, but EFH protections are not mandatory. However, none of these designations prevent the Navy from using the SDZ for its designated purposes.

Likelihood of Non-DOD Actions Subject to Critical Habitat: It is possible that non-DOD federal actions will be proposed within this site that could affect the essential feature, but that would no longer be subject to the critical habitat provision if the particular area were excluded from the designation. However, the site is off-limits for 32 weeks a year, quite remote, and not currently used for other federal activities; thus, the likelihood of non-DOD actions in the future is very low. The site is used for some recreational activities, but these are not federal actions.

Recommendation: We conclude that the impacts to national security of including this area within critical habitat do not outweigh the conservation benefits to the listed corals, and thus recommend that the Ritidian Point Surface Danger Zone complex not be excluded from proposed coral critical habitat designation. The most important factors supporting this recommendation are: (1) the national security impacts of coral critical habitat are unlikely to be either substantial or unpredictable because listed corals are known to occur at this site at least some of the time, thus the Navy would already be conducting section 7 consultations on listed corals for any of their activities that affect listed corals at this site even without critical habitat, resulting in little additional consultation work; and (2) the conservation benefits of coral critical habitat could be considerable because critical habitat would protect the high quality essential feature within the area during periods when natural disturbance causes *A. globiceps* colonies to temporarily disappear from the site. Mortality and recovery of coral populations at any given site is a normal response to natural disturbance, thus it is expected that colonies of listed corals will periodically disappear and reappear at the site in the future.

5.2.2. Tinian and Saipan: Sites No Longer Requested for Exclusion

The Tinian Unit of proposed coral critical habitat included a pair of adjacent USCG anchorages, the Tinian Explosive Anchorages A and B (see Fig. 22 in NMFS 2020a) that were requested for exclusion from proposed coral critical habitat by USCG. The majority of these two sites are ineligible for critical habitat because they fall within the Tinian MLA, but their eastern margins overlapped with proposed coral critical habitat, which was 0 – 20 m depth on Tinian. However, we found that conservation benefits outweighed national security impacts, and did not exclude these areas from the proposed rule in 2020 (85 FR 76262; November 27, 2020). Two changes in proposed coral critical habitat from the proposed rule result in nearly complete elimination of the overlap between these two sites and critical habitat: (1) Removal from proposed coral critical habitat of all soft substrates, which eliminates some of the overlap; and (2) the reduction in depth of proposed coral critical habitat to 0 – 12 m depth on Tinian, which also eliminates some of the overlap. The only remaining overlap of the two sites with proposed coral critical habitat is some spur and groove forereef along the extreme eastern margins of the two areas. However, these areas are not and cannot be used for anchoring, because they are too shallow and turbulent. Thus, USCG no longer requests exclusion of the two areas from coral critical habitat (Kebby Kelley, pers. comm., Nov-21).

The Saipan Unit of proposed coral critical habitat included a group of six Navy anchorage berths, L-19, L-32, L-44, L-47, L-62, and M-16 (see Fig. 23 in NMFS 2020a) that were requested for exclusion from proposed coral critical habitat by Navy. We found that national security impacts outweighed conservation benefits and excluded the six berths from the proposed rule in 2020 (85 FR 76262; November 27, 2020). In 2021, Navy requested exclusion from proposed coral critical habitat of an additional six anchorage berths in the area, L-8, L-10, L-49, L-59, L-69 and M-8 (Julie Rivers, Navy Pacific Fleet, pers. comm., Mar-21). However, since the minimum depths of all 12 berths are >12 m, and the depth of proposed coral critical habitat on Saipan has been reduced to 0 – 12 m, there is no longer any overlap between the 12 berths and proposed coral critical habitat. Thus, the Navy no longer requests exclusion of the 12 berths from coral critical habitat (J. Rivers, Navy Pacific Fleet, pers. comm., Nov-21).

5.3. Other Relevant Impacts

Other relevant impacts include the benefits of critical habitat designation, and impacts on governmental or private entities that are implementing existing management plans that provide benefits to the listed species. These other relevant impacts are described below for coral critical habitat.

5.3.1. Benefits of Critical Habitat

The three main types of benefits of critical habitat designation are increased probability of conservation and recovery of the listed corals, ecosystem service benefits of coral reef conservation, and education and awareness:

(1) Increased probability of conservation and recovery of the listed corals: The most direct benefits of the critical habitat designation stem from the enhanced probability of conservation and recovery of the listed corals. Such conservation benefits result from the increased protection of the essential feature from federal actions provided by coral critical habitat. As described in section 3.4.19 above, while listed corals are generally distributed throughout the specific areas, resulting in low incremental impacts of critical habitat, there are still many locations on smaller spatial scales within the specific areas that lack colonies of listed corals at any given point in time. That is, colonies of listed corals decrease or disappear from particular locations in response to local disturbances, then return and increase as local conditions improve. Such dynamic spatial and temporal fluctuation in the distributions of colonies of listed corals within the specific areas is a natural process. Critical habitat thereby protects the essential feature in the locations that lack colonies of listed corals when federal actions are proposed at that location.

(2) Ecosystem service benefits of coral reef conservation: Overall, coral reef ecosystems, including those comprising populations of the listed corals, provide important ecosystem services of value to individuals, communities, and economies. These include recreational opportunities (and associated tourism spending in the regional economy), habitat and nursery functions for recreationally and commercially valuable fish species, shoreline protection in the form of wave attenuation and reduced beach erosion, and climate stabilization via carbon sequestration. The total economic value of coral reefs in the three U.S. Pacific Islands jurisdictions where coral critical habitat is being broadly proposed in 2021 dollars is: (1) American Samoa - $13.4 million/year, (2) Guam - $165.0 million/year, and (3) CNMI - $60.4 million/year (section 7.1 of Appendix C). Efforts to conserve the listed corals also benefit the broader reef ecosystems, thereby preserving or improving these ecosystem services and values (NOAA Coral Reef Conservation Program 2013).

Conservation benefits to each listed coral species in all their critical habitat units are expected to result from proposed critical habitat designation. Critical habitat most directly influences the recovery potential of the species and protects coral reef ecosystem services through its implementation under section 7 of the ESA. That is, these benefits stem from the implementation of project modifications undertaken to avoid destruction and adverse modification of critical habitat. Accordingly, critical habitat designation is most likely to generate the benefits discussed in those areas expected to be subject to additional recommendations for project modifications (above and beyond any conservation measures that may be implemented in the baseline due to the listing status of the species or for other reasons). In addition, critical habitat designation may generate ancillary environmental improvements and associated ecosystem service benefits (i.e., to commercial fishing and recreational activities) in areas subject to incremental project modifications. While neither benefit can be directly monetized, existing information on the value of coral reefs provides an indication of the value placed on those ecosystems (section 7.2 of Appendix C).

(3) Education and Awareness Benefits that May Result from the Designation: There is the potential for education and awareness benefits arising from the critical habitat designation. This potential stems from two sources: (1) Entities that engage in section 7 consultation; and (2) members of the general public interested in coral conservation. The former potential exists from parties who alter their activities to benefit the species or essential feature because they were made aware of the critical habitat designation through the section 7 consultation process. The latter may engage in similar efforts because they learned of the critical habitat designation through outreach materials.

Similarly, state and local governments may be prompted to enact laws or rules to complement the critical habitat designation and benefit the listed corals. Those laws would likely result in additional impacts of the designation. However, we are unable to quantify the beneficial effects of the awareness gained through or the secondary impacts from state and local regulations resulting from the critical habitat designation.

5.3.2. Impacts to Governmental and Private Entities

Many previous critical habitat impact analyses evaluated the impacts of the designation on relationships with, or the efforts of, private and public entities involved in management or conservation efforts benefiting listed species. These analyses found that the additional regulatory layer of a designation could negatively impact the conservation benefits provided to the listed species by existing or proposed management or conservation plans. For example, section 7 consultation with NMFS by a marine protected area agency on the effects of their management plan on critical habitat could cause delays to projects that benefit the listed species.

There are a large number of federal marine protected areas in American Samoa, Guam, CNMI, PRIA, and NWHI where proposed coral critical habitat is being considered (listed in Table 12 of Appendix C), many of which have draft or final management plans (NPSA 1997, NOAA-USFWS-HI 2008, USFWS 2009, FBNMS 2012, USFWS 2014, NOAA-USFWS-CNMI 2020). Impacts of critical habitat designation on the agencies responsible for natural resource management planning of these areas depend on the type and number of section 7 consultations that may result from the designation in the areas covered by those plans, as well as any potential project modifications recommended by these consultations. Negative impacts to these entities could result if the critical habitat designation interferes with these agencies' ability to provide for the conservation of the species, or otherwise hampers management of these areas.

Existing or proposed management plans in the marine protected areas and their associated regulations protect existing coral reef resources, but they may not specifically protect the substrate and water quality feature for purposes of increasing listed coral abundance and eventual recovery. However, section 7 consultations on implementation of these federal marine protected area plans over the next 10 years are not expected to result in incremental project modifications, thus any section 7 impacts will likely be limited to administrative costs. In addition, we found no evidence that coral critical habitat designation would interfere with these agencies' ability to implement their management plans, or would otherwise hamper their management of these areas.

5.4. 4(b)(2) Conclusion

Based on the 4(b)(2) economic impact analysis in section 5.1 above, economic impacts of proposed coral critical habitat are likely to be low, even on the islands with concentrated economic activity (Tutuila, Guam, Saipan). Since these are the three units where most future proposed federal actions that could affect critical habitat are expected (Appendix C), the conservation benefits of critical habitat are the greatest in these three units. Thus, economic impacts do not outweigh conservation benefits, and no exclusions from proposed coral critical habitat should be made.

Based on the 4(b)(2) national security impact analysis in section 5.2 above, the conservation benefits of designation outweight the national security impacts of proposed coral critical habitat at the Navy's Ritidian Point Surface Danger Zone complex. Thus, national security impacts do not outweigh conservation benefits, and no exclusions from proposed coral critical habitat should be made.

6. Conclusion and Maps of Proposed Coral Critical Habitat

We used a systematic methodology to compile, assess, and interpret the records of ESA-listed corals species to identify 18 U.S. islands that are within the occupied area for at least one listed species (Section 2.1). For each of the five listed species within U.S. waters, we identified the islands included in the occupied area and the depth range of the species around each island (Section 3.1). All five species have the same essential feature (Section 3.2). The specific areas containing the essential feature are described for each of the 18 island units, which are the areas that were considered for proposed coral critical habitat (Section 3.4). These areas were subjected to 4(a)(3) analyses, resulting in two entire islands (FDM and Wake Atoll) being ineligible for coral critical habitat, as well as large portions of Guam and Tinian (Section 4), reducing the total number of coral critical habitat units from 18 to 16 islands. These remaining 16 island units were then subjected to 4(b)(2) economic and national security impact analyses, resulting in no proposed exclusions (Section 5). Proposed critical habitat for each of the five listed coral species is summarized below and in Table 10. The specific areas of proposed critical habitat within the 16 island units for the 5 listed coral species are shown on the 24 maps in Section 6.1.7. below. Multiple substrate data sources were used for the maps, as cited in the island sub-sections in Section 3.4 above.

6.1.1. *Acropora globiceps*

Proposed coral critical habitat for *A. globiceps* includes specific areas within certain depth ranges around the following 16 islands in 5 jurisdictions, as described below, summarized in Table 10, and shown in the 16 color-coded maps (*A. globiceps* is blue):

1. Tutuila and Offshore Banks (American Samoa): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.1 within a depth range of 0 – 20 m, as shown in Fig. 2 below.
2. Ofu-Olosega (American Samoa): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.2 within a depth range of 0 – 20 m, as shown in Fig. 7 below.
3. Ta'u (American Samoa): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.3 within a depth range of 0 – 20 m, as shown in Fig. 10 below.
4. Rose Atoll (American Samoa): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.4 within a depth range of 0 – 10 m, as shown in Fig. 12 below.
5. Guam (Guam): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.5 within a depth range of 0 – 12 m, as shown in Fig. 14 below. Several areas on the west and north sides of the island are ineligible due to 4(a)(3) (Fig. 14).
6. Rota (CNMI): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.6 within a depth range of 0 – 12 m, as shown in Fig. 15 below.
7. Aguijan (CNMI): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.7 within a depth range of 0 – 12 m, as shown in Fig. 16 below.
8. Tinian (CNMI): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.8 within a depth range of 0 – 12 m, as shown in Fig. 17 below. Most of the island is ineligible due to 4(a)(3) (Fig. 17).

9. Saipan (CNMI): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.9 within a depth range of 0 – 12 m, as shown in Fig. 18 below.
10. Alamagan (CNMI): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.11 within a depth range of 0 – 12 m, as shown in Fig. 19 below.
11. Pagan (CNMI): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.12 within a depth range of 0 – 12 m, as shown in Fig. 20 below.
12. Maug Islands (CNMI): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.13 within a depth range of 0 – 12 m, as shown in Fig. 21 below.
13. Uracas (CNMI): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.14 within a depth range of 0 – 12 m, as shown in Fig. 22 below.
14. Palmyra Atoll (PRIA): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.15 within a depth range of 0 – 12 m, as shown in Fig. 23 below.
15. Johnston Atoll (PRIA): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.16 within a depth range of 0 – 12 m, as shown in Fig. 24 below.
16. French Frigate Shoals (Hawaii): Proposed critical habitat for *A. globiceps* in this unit includes the specific areas described in Section 3.4.18 within a depth range of 0 – 12 m, as shown in Fig. 25 below.

6.1.2. *Acropora retusa*

Proposed coral critical habitat for *A. retusa* includes specific areas within certain depth ranges around the following three islands in American Samoa, as described below, summarized in Table 10, and shown in the three color-coded maps (*A. retusa* is purple):

1. Tutuila and Offshore Banks (American Samoa): Proposed critical habitat for *A. retusa* in this unit includes the specific areas described in Section 3.4.1 within a depth range of 0 – 20 m, as shown in Fig. 3 below.
2. Ofu-Olosega (American Samoa): Proposed critical habitat for *A. retusa* in this unit includes the specific areas described in Section 3.4.2 within a depth range of 0 – 20 m, as shown in Fig. 8 below.
3. Rose Atoll (American Samoa): Proposed critical habitat for *A. retusa* in this unit includes the specific areas described in Section 3.4.4 within a depth range of 0 – 20 m, as shown in Fig. 13 below.

6.1.3. *Acropora speciosa*

Proposed coral critical habitat for *A. speciosa* includes specific areas within 20 – 50 m around Tutuila and its offshore banks in American Samoa, as summarized in Table 10, and shown in the color-coded map (*A. speciosa* is magenta, Fig. 4).

6.1.4. *Euphyllia paradivisa*

Proposed coral critical habitat for *E. paradivisa* includes specific areas within 20 – 50 m around Tutuila and its offshore banks in American Samoa, as summarized in Table 10 and shown in the color-coded map (*E. paradivisa* is green, Fig. 5).

6.1.5. *Isopora crateriformis*

Proposed coral critical habitat for *I. crateriformis* includes specific areas within certain depth ranges around the following three islands in American Samoa, as described below, summarized in Table 10, and shown in the three color-coded maps (*I. crateriformis* is brown):

1. Tutuila and Offshore Banks (American Samoa): Proposed critical habitat for *I. crateriformis* in this unit includes the specific areas described in Section 3.4.1 within a depth range of 0 – 20 m, as shown in Fig. 6 below.
2. Ofu-Olosega (American Samoa): Proposed critical habitat for *I. crateriformis* in this unit includes the specific areas described in Section 3.4.2 within a depth range of 0 – 20 m, as shown in Fig. 9 below.
3. Ta'u (American Samoa): Proposed critical habitat for *I. crateriformis* in this unit includes the specific areas described in Section 3.4.3 within a depth range of 0 – 20 m, as shown in Fig. 11 below.

6.1.6. Summary Table

Proposed critical habitat for each of the five listed coral species is summarized in the columns of Table 10 below. The American Samoa units have overlapping critical habitat designations for multiple listed species, as shown in the rows of Table 10, including Tutuila and Offshore Banks (five spp.), Ofu-Olosega (three spp.), and Ta'u and Rose Atoll (two spp. each).

Table 10. The 16 island units that contain proposed critical habitat for the 5 listed coral species. For each species, depth ranges in meters and figure numbers ("Fig.") for the maps are shown. Maps showing areas that were deemed ineligible for designation of critical habitat by the 4(a)(3)(B)(i) INRMP analyses are also noted.

Island (Unit)	*A. globiceps*		*A. retusa*		*A. speciosa*		*E. paradivisa*		*I. crateriformis*		4(a)(3)(B)(i)
	Depth	Fig.	Depth	Fig.	Depth	Fig.	Depth	Fig.	Depth	Fig.	Fig.
Tutuila and Offshore Banks	0-20	2	0-20	3	20-50	4	20-50	5	0-20	6	-
Ofu-Olosega	0-20	7	0-20	8	-	-	-	-	0-20	9	-
Ta'u	0-20	10	-	-	-	-	-	-	0-20	11	-
Rose Atoll	0-10	12	0-20	13	-	-	-	-	-	-	-
Guam	0-12	14	-	-	-	-	-	-	-	-	14
Rota	0-12	15	-	-	-	-	-	-	-	-	-
Aguijan	0-12	16	-	-	-	-	-	-	-	-	-
Tinian	0-12	17	-	-	-	-	-	-	-	-	17
Saipan	0-12	18	-	-	-	-	-	-	-	-	-

FDM	0-12	*	-	-	-	-	-	-	-	-	*
Alamagan	0-12	19	-	-	-	-	-	-	-	-	-
Pagan	0-12	20	-	-	-	-	-	-	-	-	-
Maug Islands	0-12	21	-	-	-	-	-	-	-	-	-
Uracas	0-12	22	-	-	-	-	-	-	-	-	-
Palmyra Atoll	0-10	23	-	-	-	-	-	-	-	-	-
Johnston Atoll	0-10	24	-	-	-	-	-	-	-	-	-
Wake Atoll	0-10	*	0-20	*	-	-	-	-	-	-	*
FFS	0-10	25	-	-	-	-	-	-	-	-	-

**No maps needed for Farallon de Medinilla or Wake Atoll because entire area around each island ineligible for coral critical habitat due to 4(a)(3).

6.1.7. **Maps**

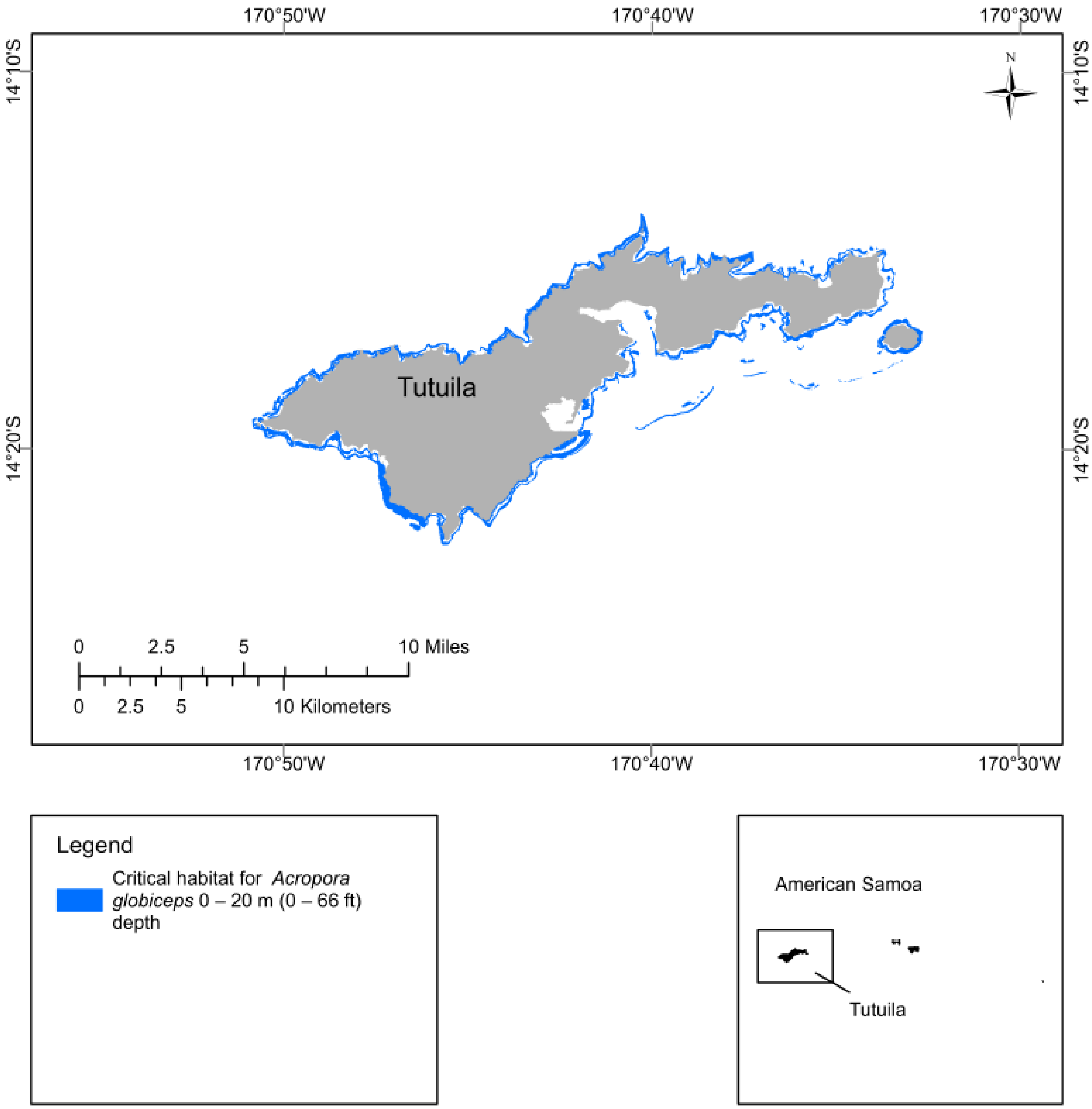

Figure 2. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 20 m depth, blue) in the Tutuila and Offshore Banks Unit.

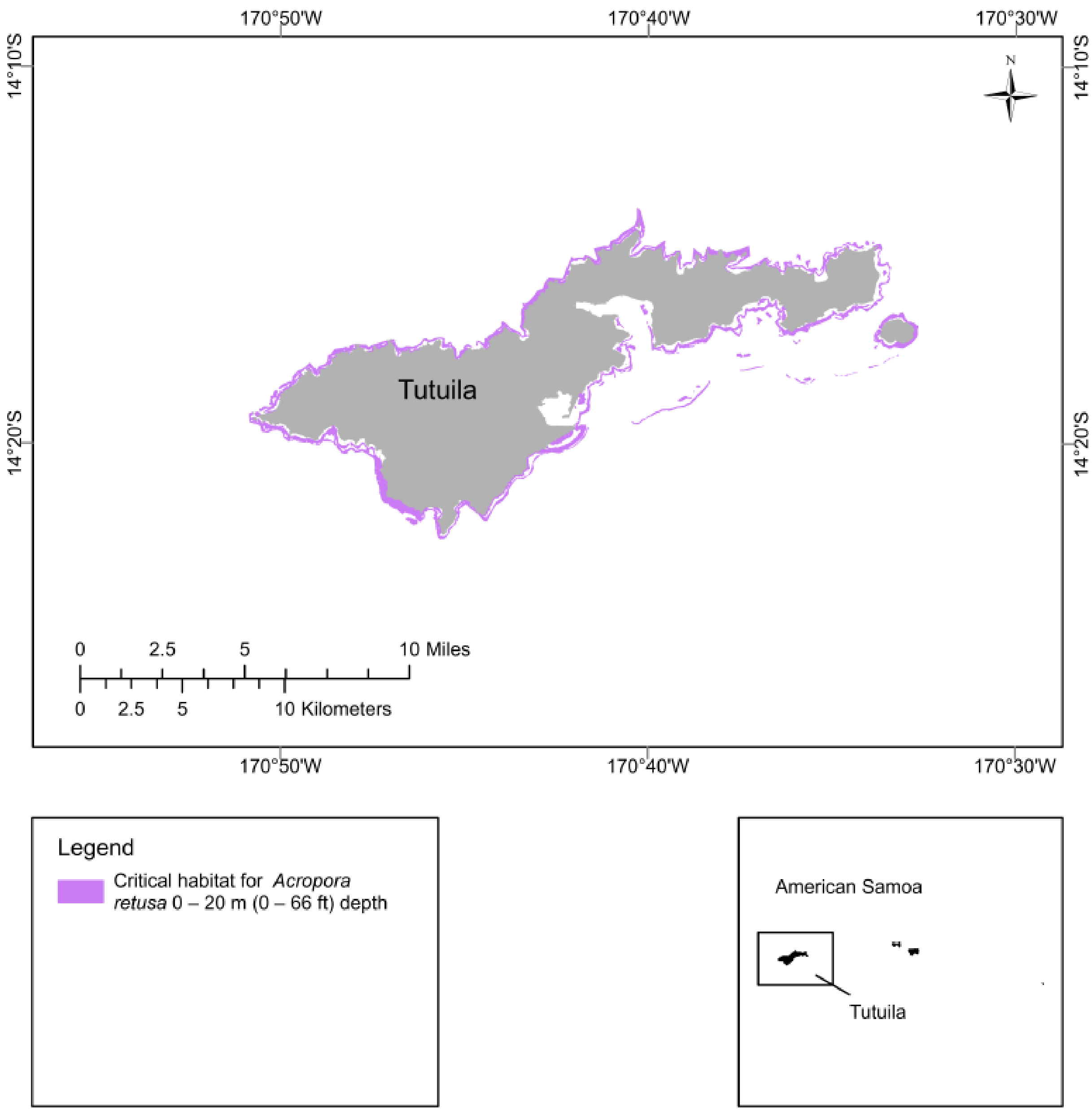

Figure 3. Specific areas of proposed coral critical habitat for *A. retusa* (0 – 20 m depth, purple) in the Tutuila and Offshore Banks Unit.

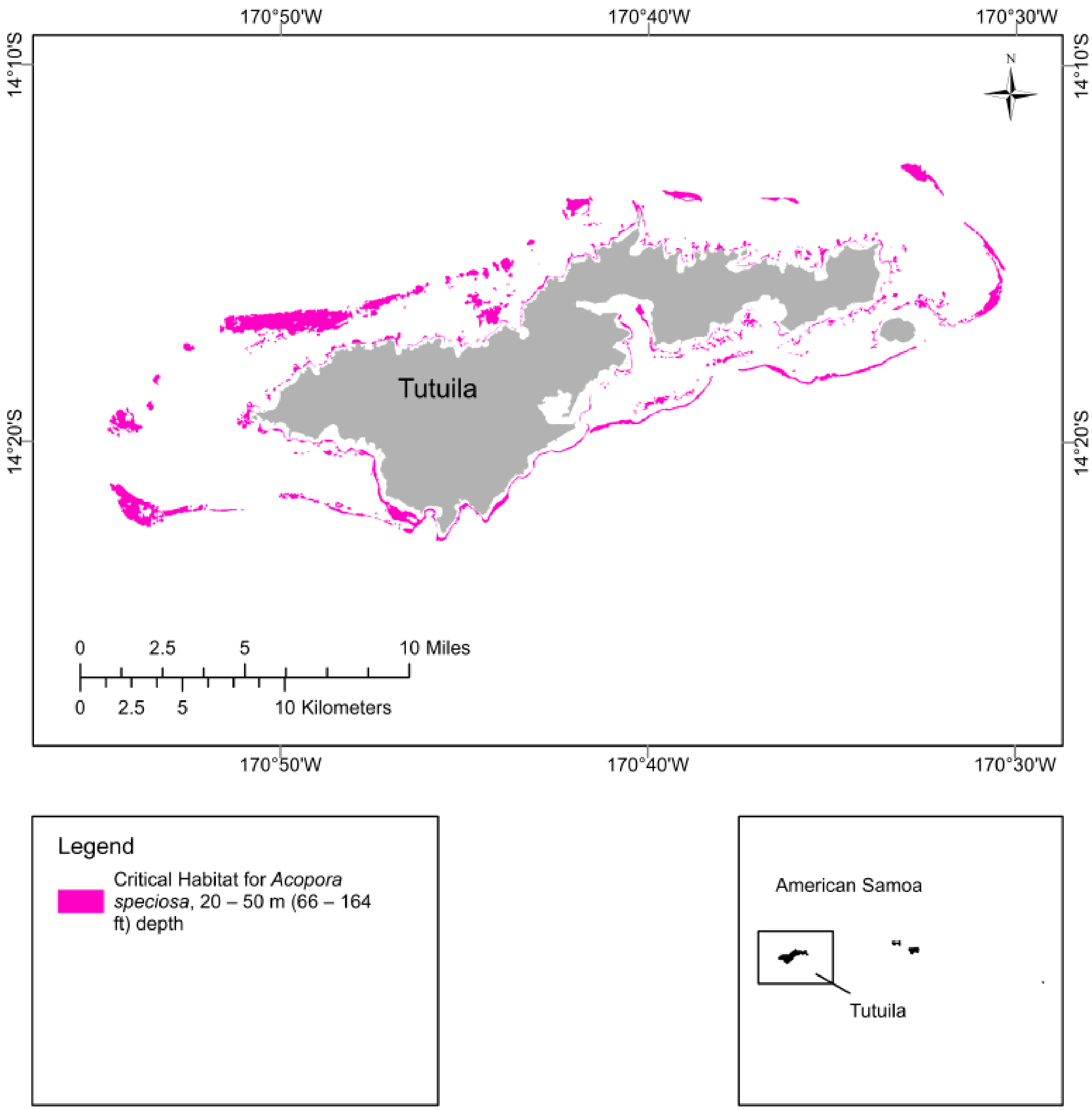

Figure 4. Specific areas of proposed coral critical habitat for *A. speciosa* (20 – 50 m depth, magenta) in the Tutuila and Offshore Banks Unit.

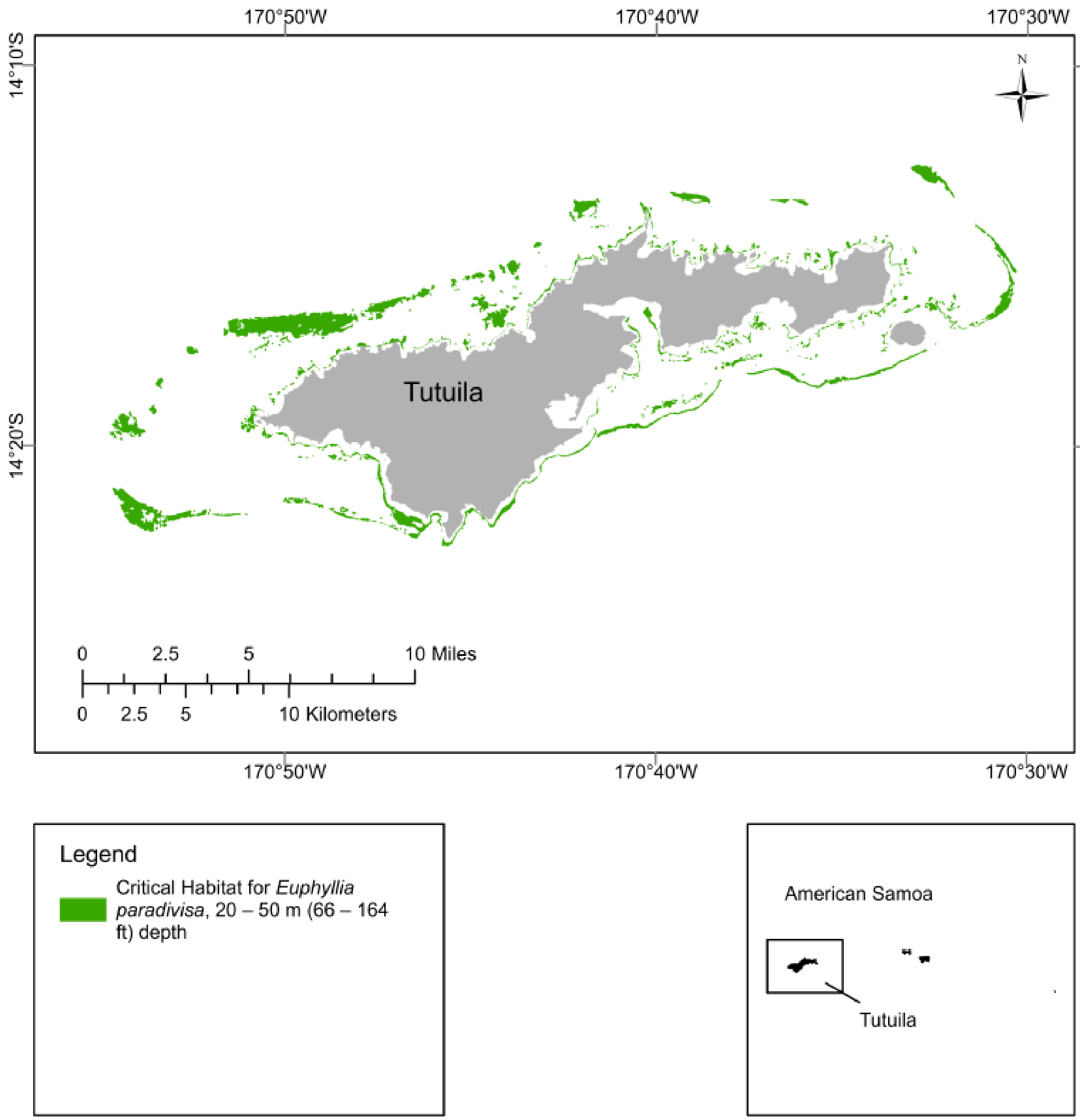

Figure 5. Specific areas of proposed coral critical habitat for *E. paradivisa* (20 – 50 m depth, green) in the Tutuila and Offshore Banks Unit.

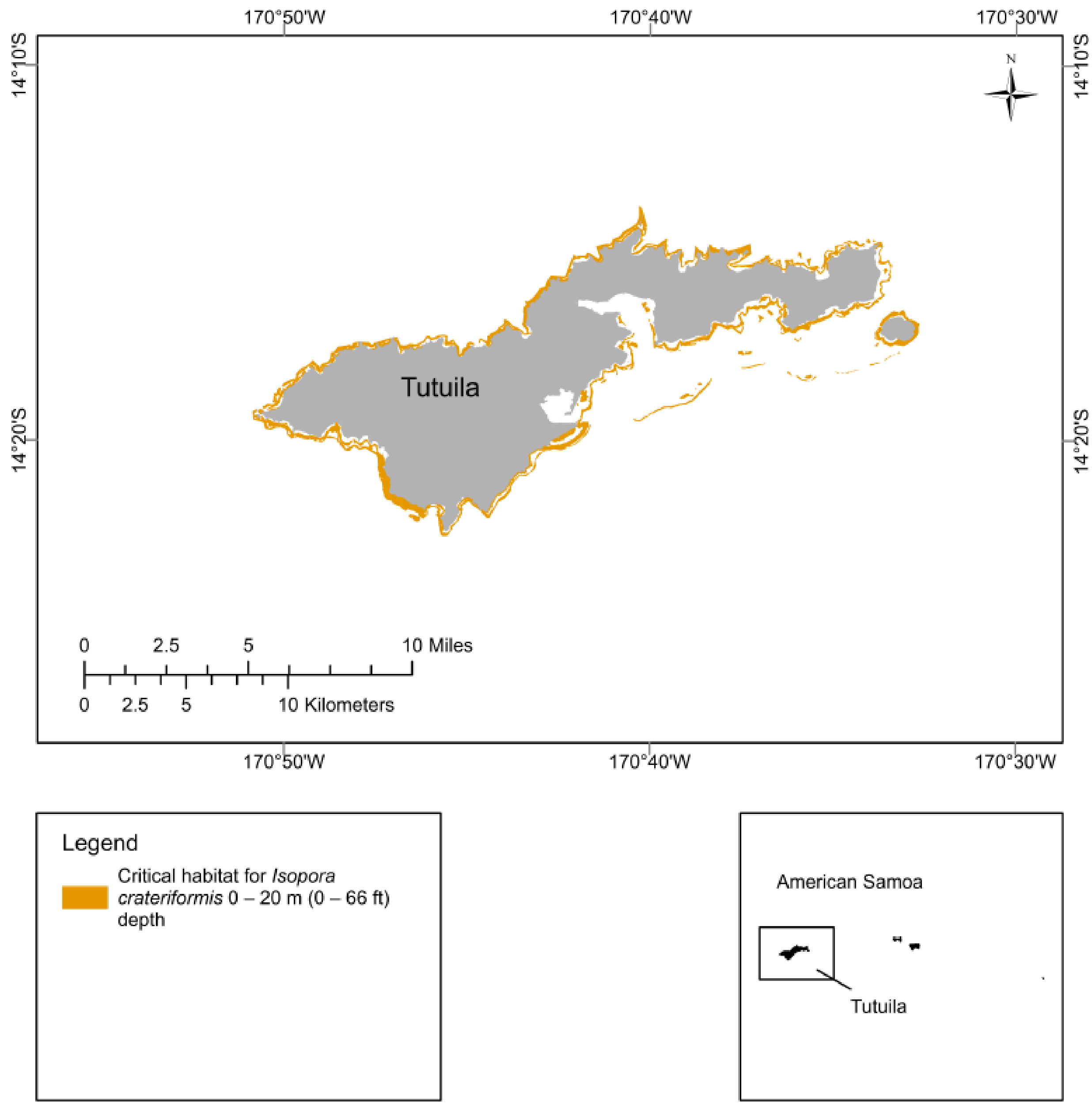

Figure 6. Specific areas of proposed coral critical habitat for *I. crateriformis* (0 – 20 m depth, brown) in the Tutuila and Offshore Banks Unit.

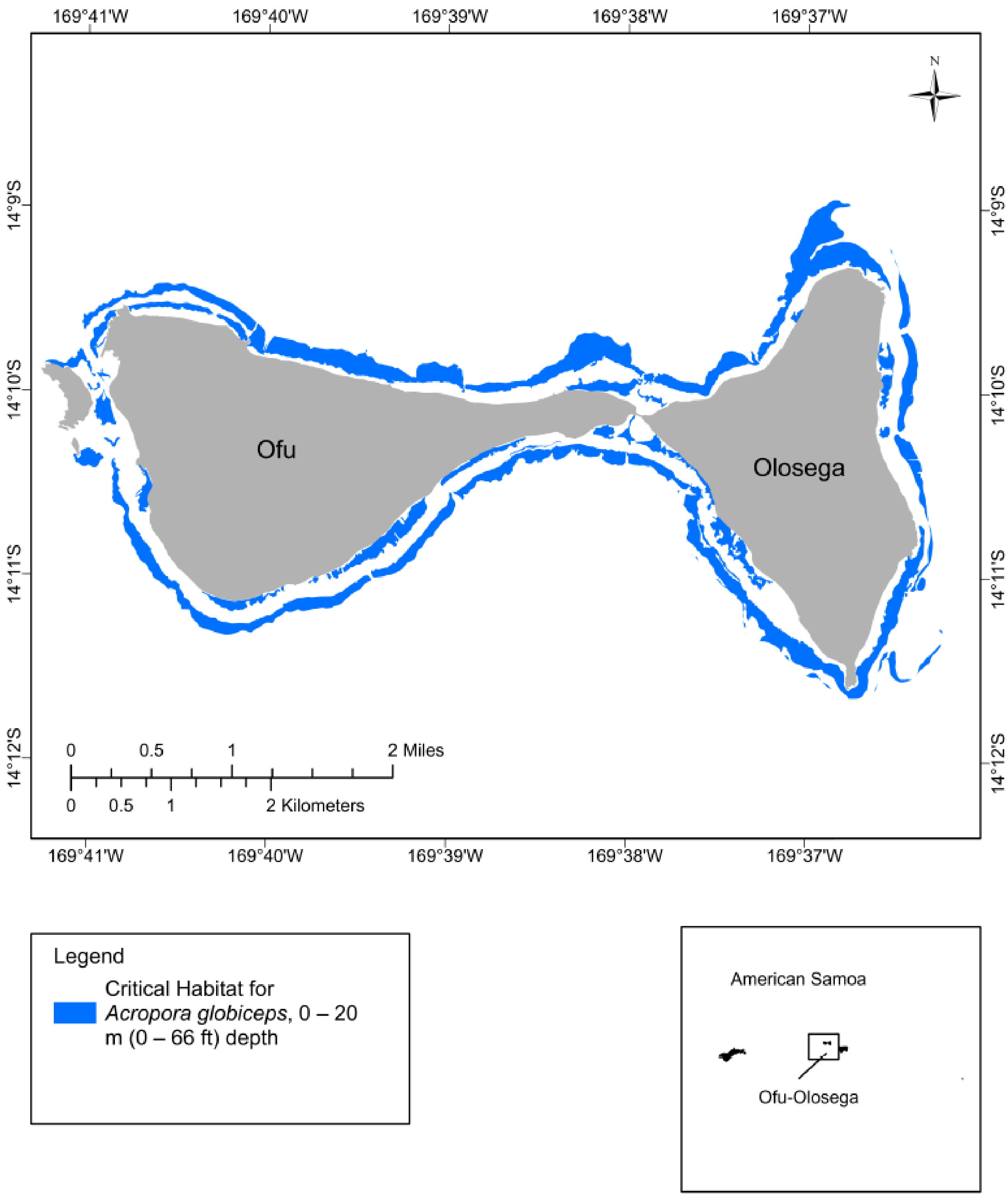

Figure 7. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 20 m depth, blue) in the Ofu-Olosega Unit.

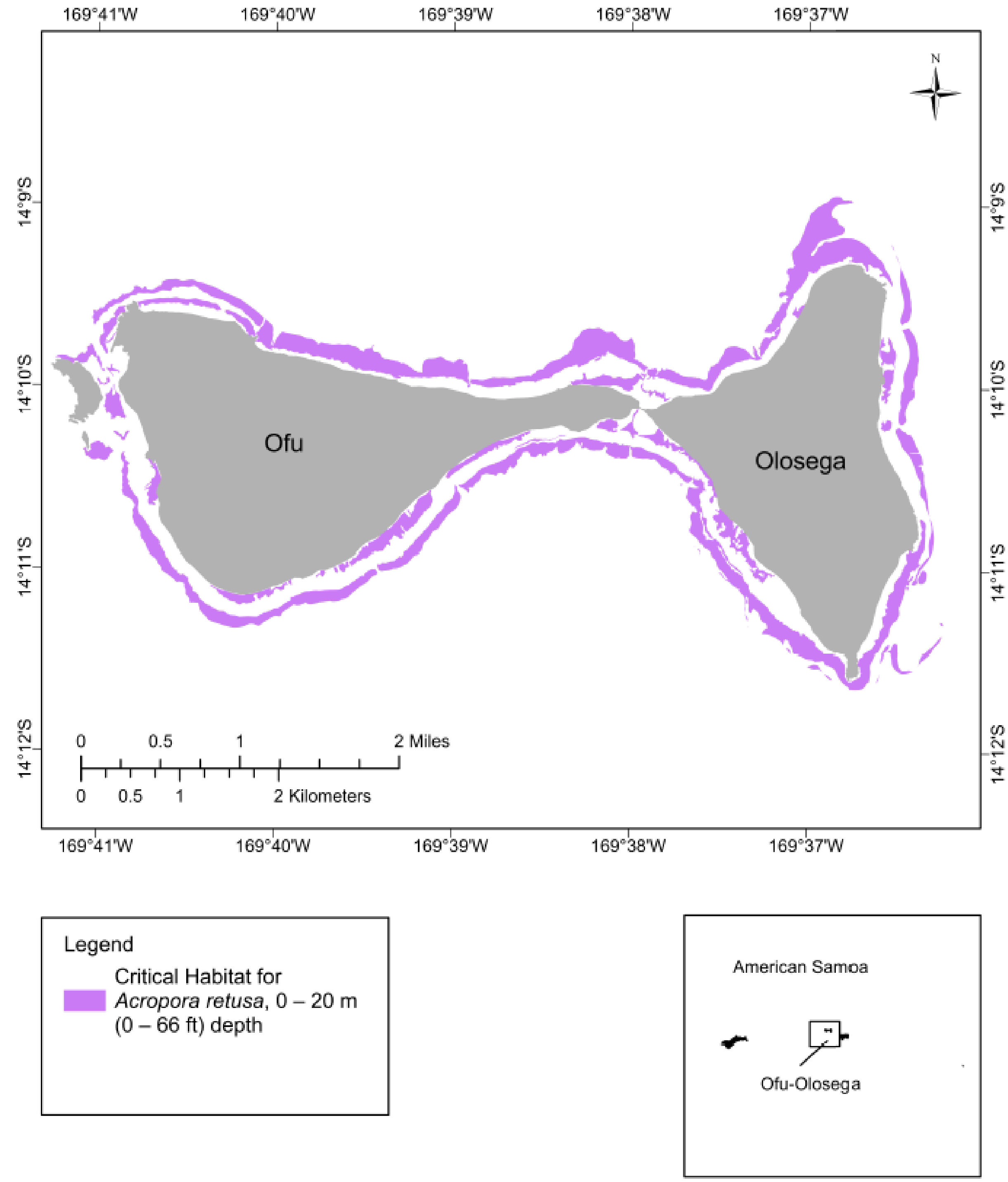

Figure 8. Specific areas of proposed coral critical habitat for *A. retusa* (0 – 20 m depth, purple) in the Ofu-Olosega Unit.

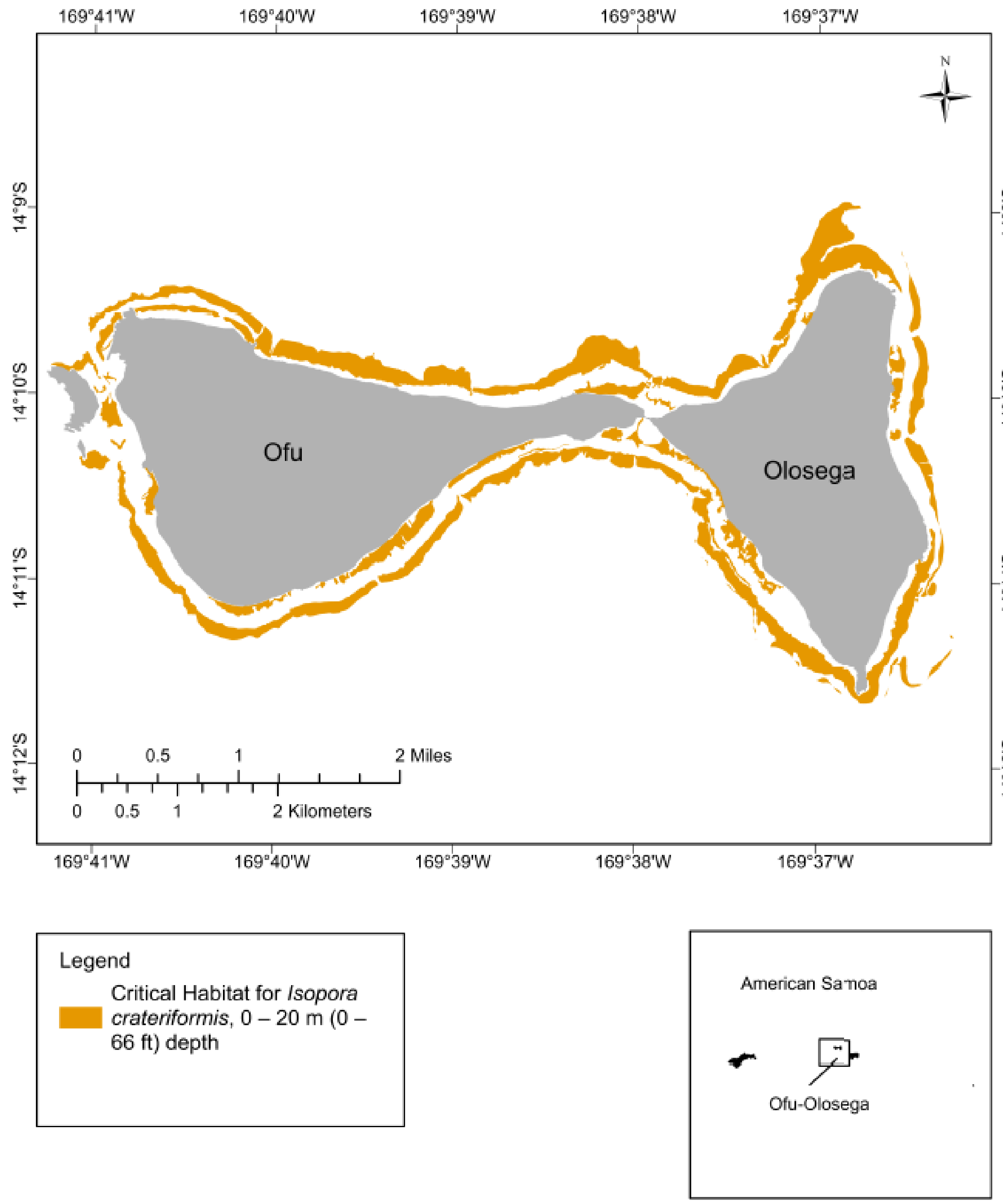

Figure 9. Specific areas of proposed coral critical habitat for *I. crateriformis* (0 – 20 m depth, brown) in the Ofu-Olosega Unit.

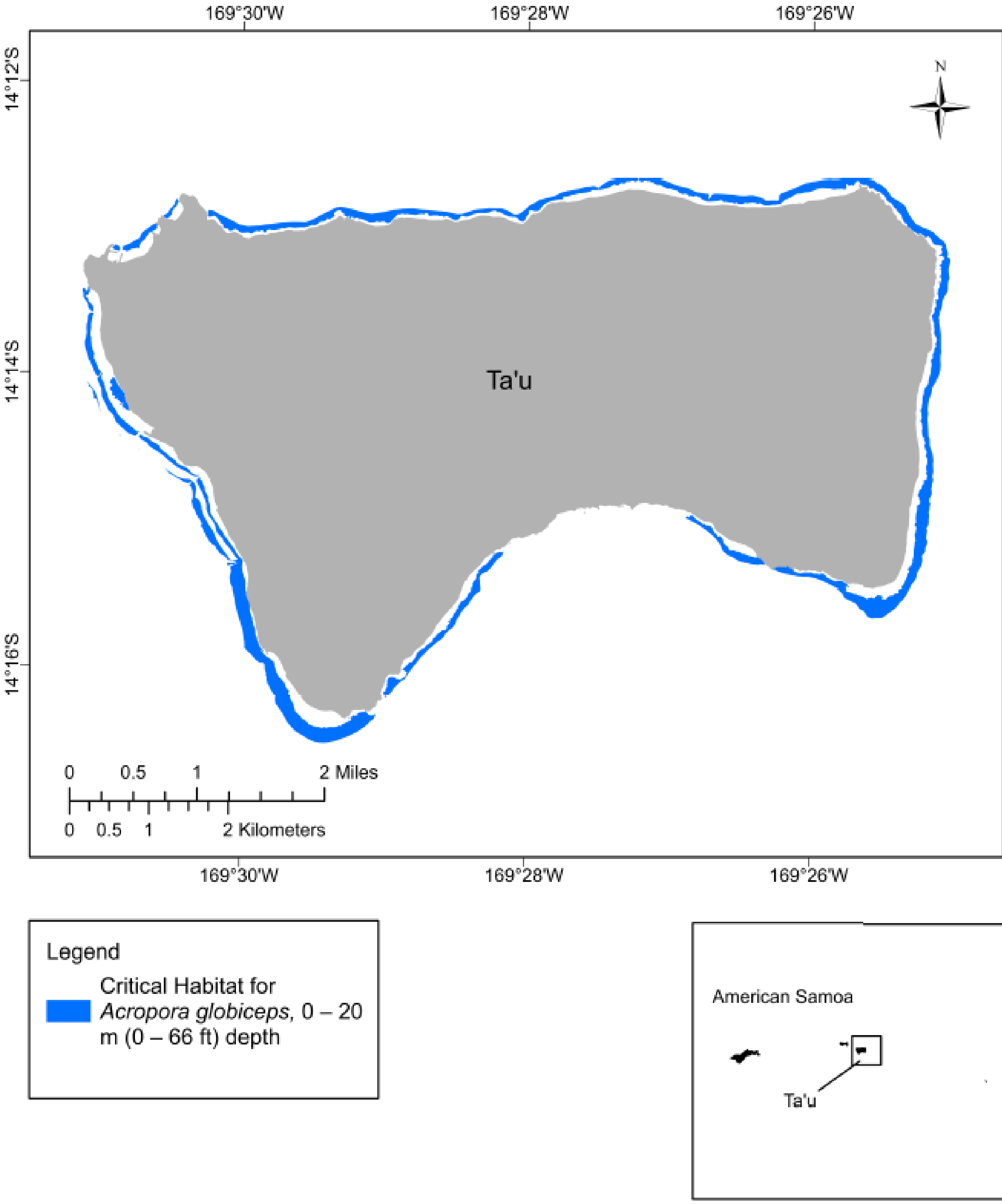

Figure 10. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 20 m depth, blue) in the Ta'u Unit.

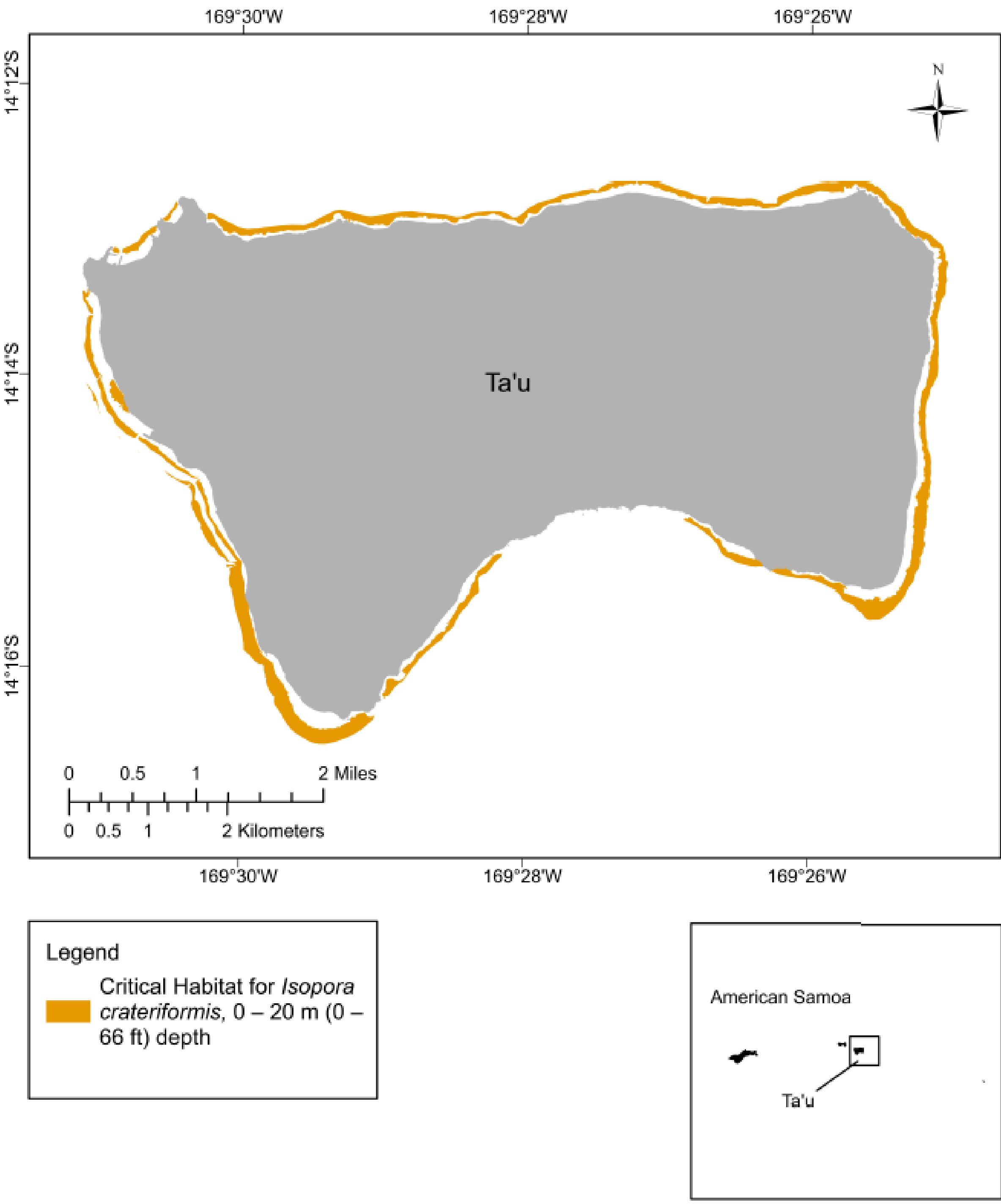

Figure 11. Specific areas of proposed coral critical habitat for *I. crateriformis* (0 – 20 m depth, brown) in the Ta'u Unit.

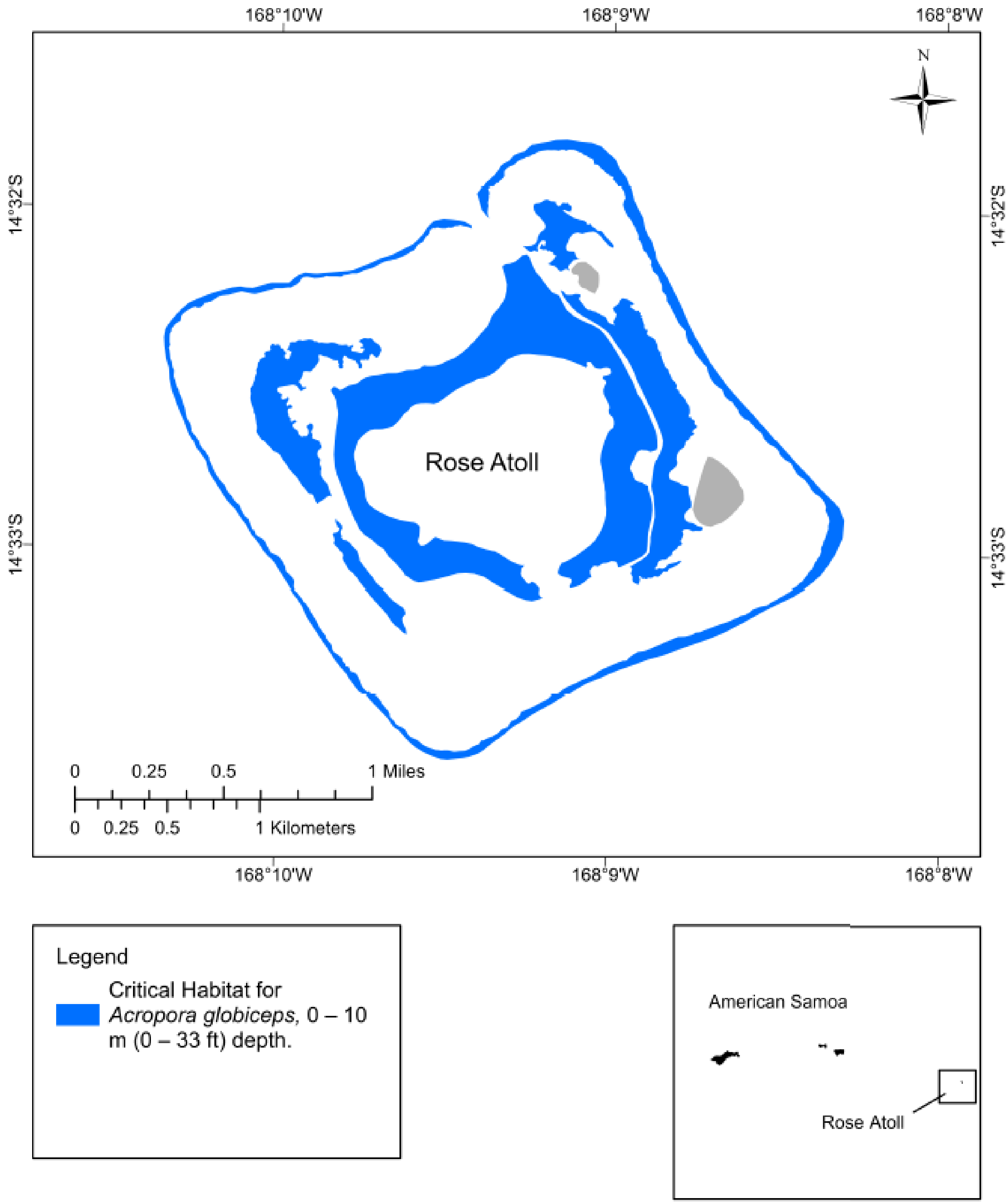

Figure 12. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 10 m depth, blue) in the Rose Atoll Unit.

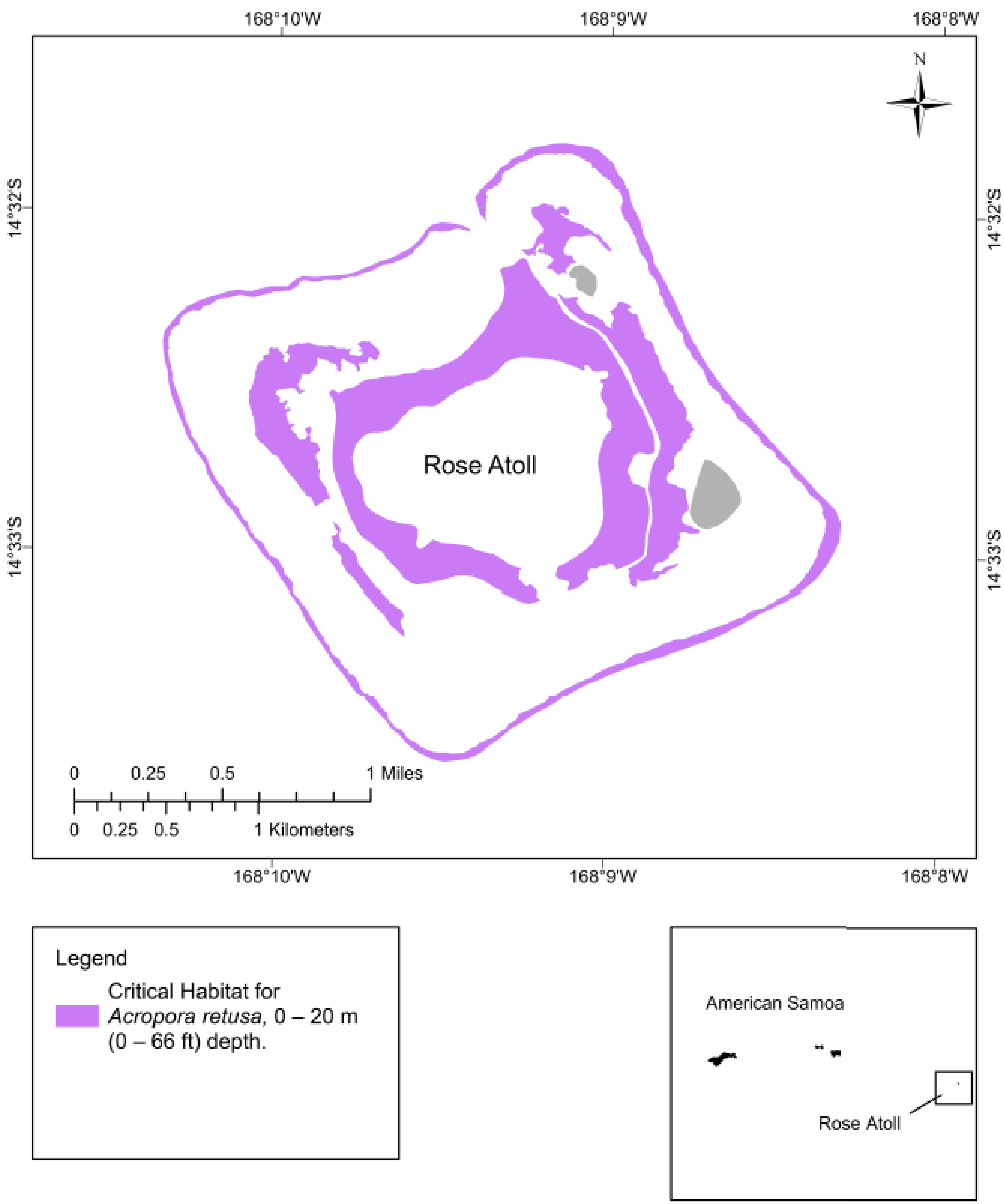

Figure 13. Specific areas of proposed coral critical habitat for *A. retusa* (0 – 20 m depth, purple) in the Rose Atoll Unit.

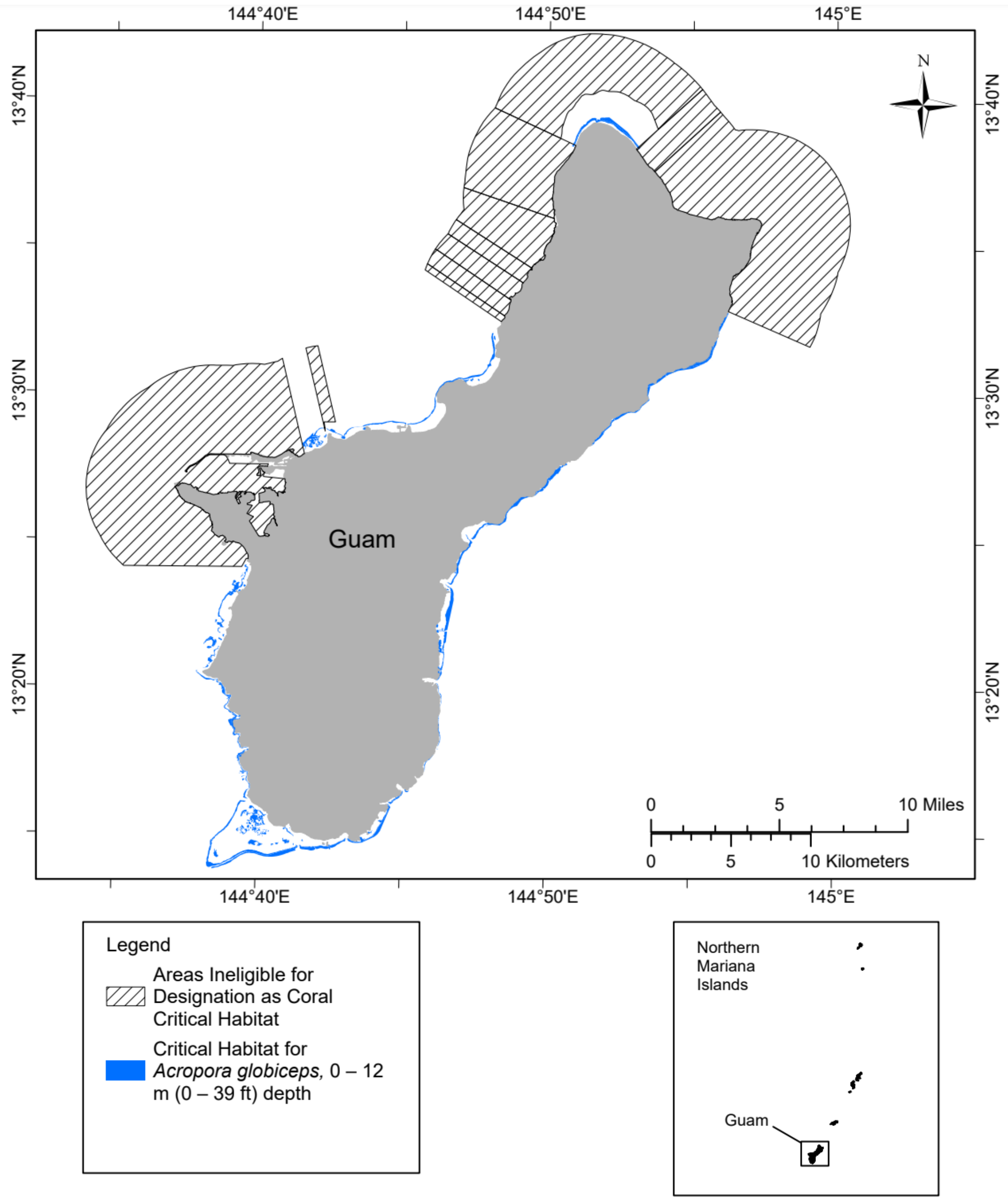

Figure 14. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 12 m depth, blue) in the Guam Unit.

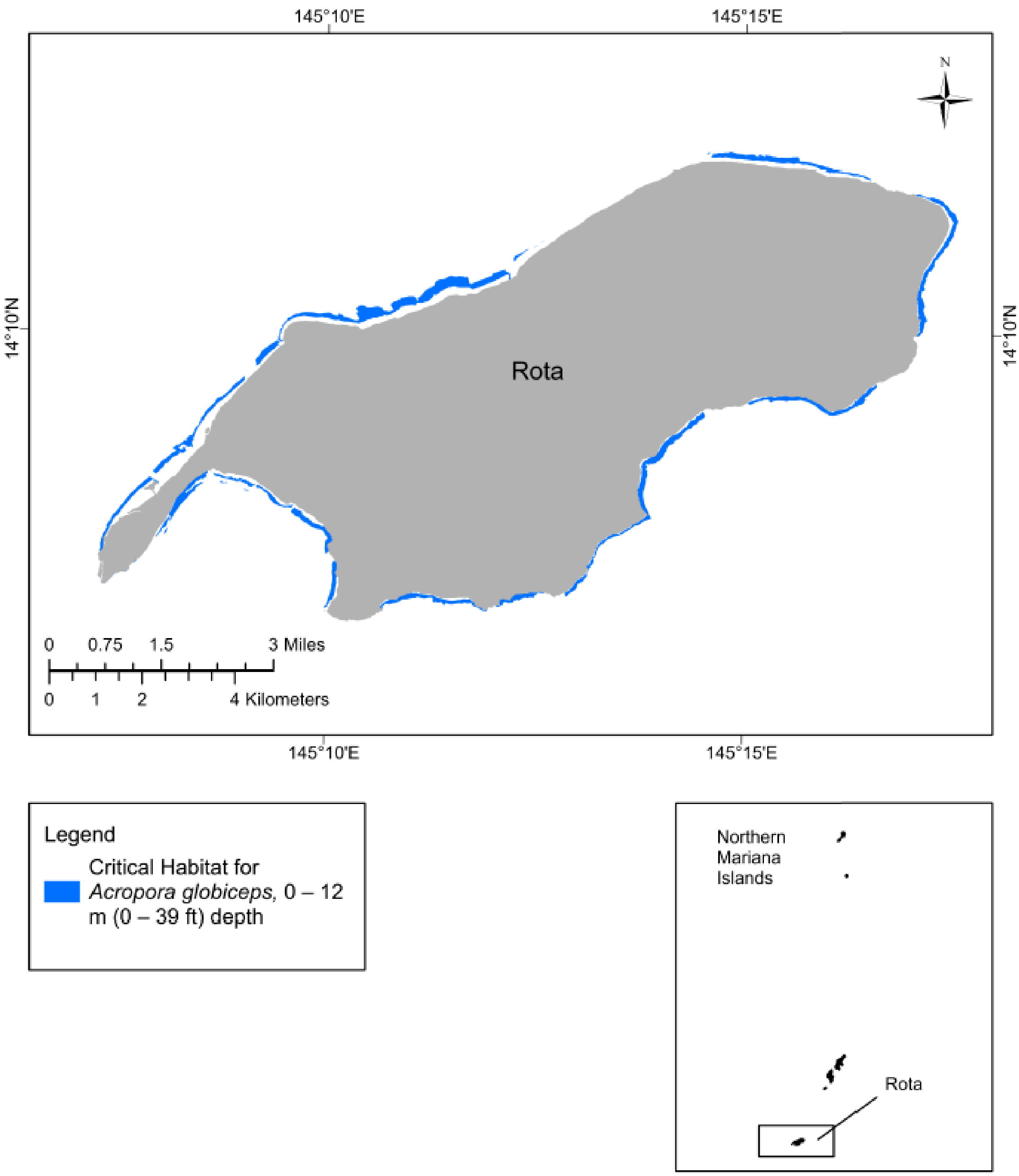

Figure 15. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 12 m depth, blue) in the Rota Unit.

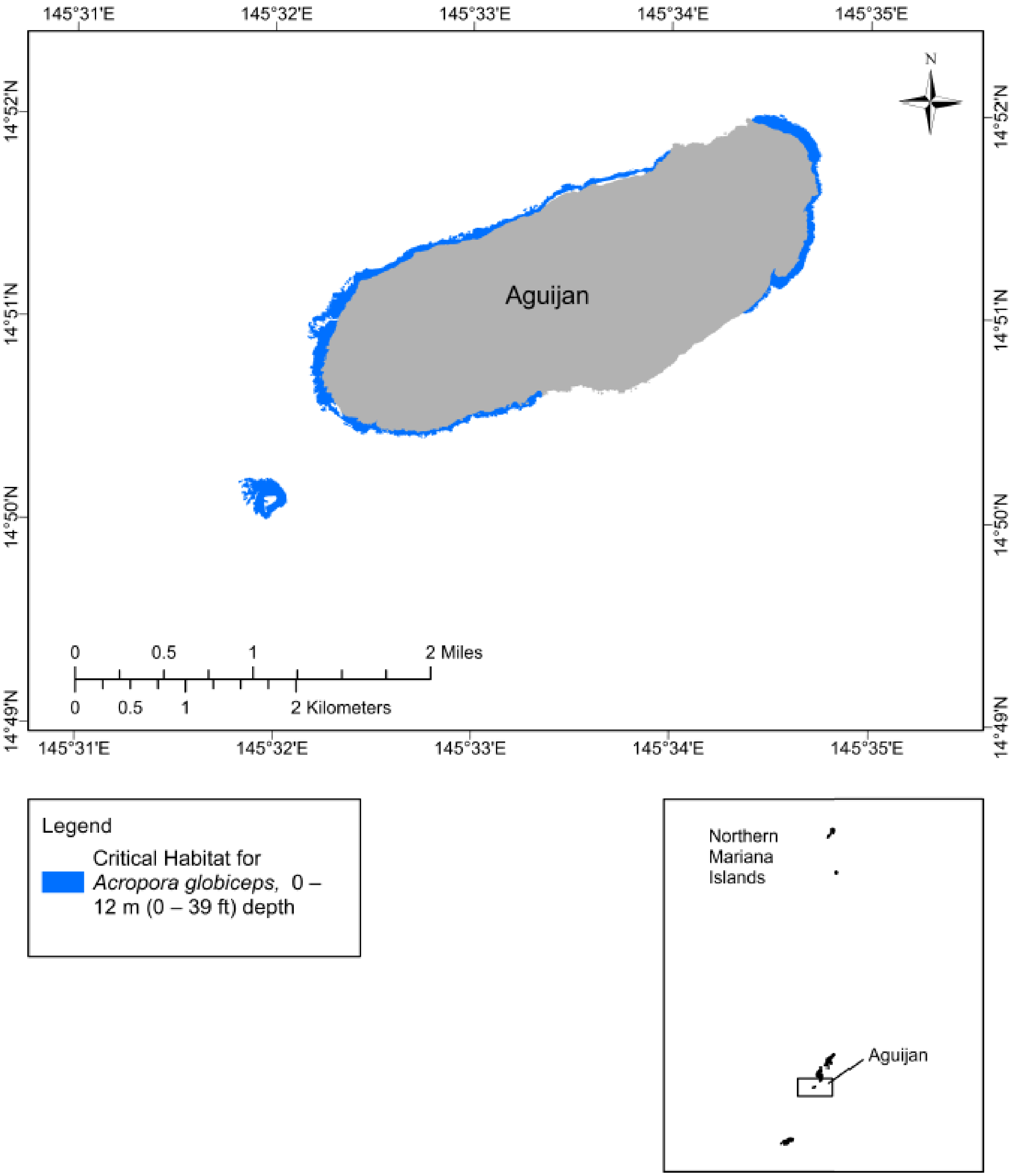

Figure 16. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 12 m depth, blue) in the Aguijan Unit.

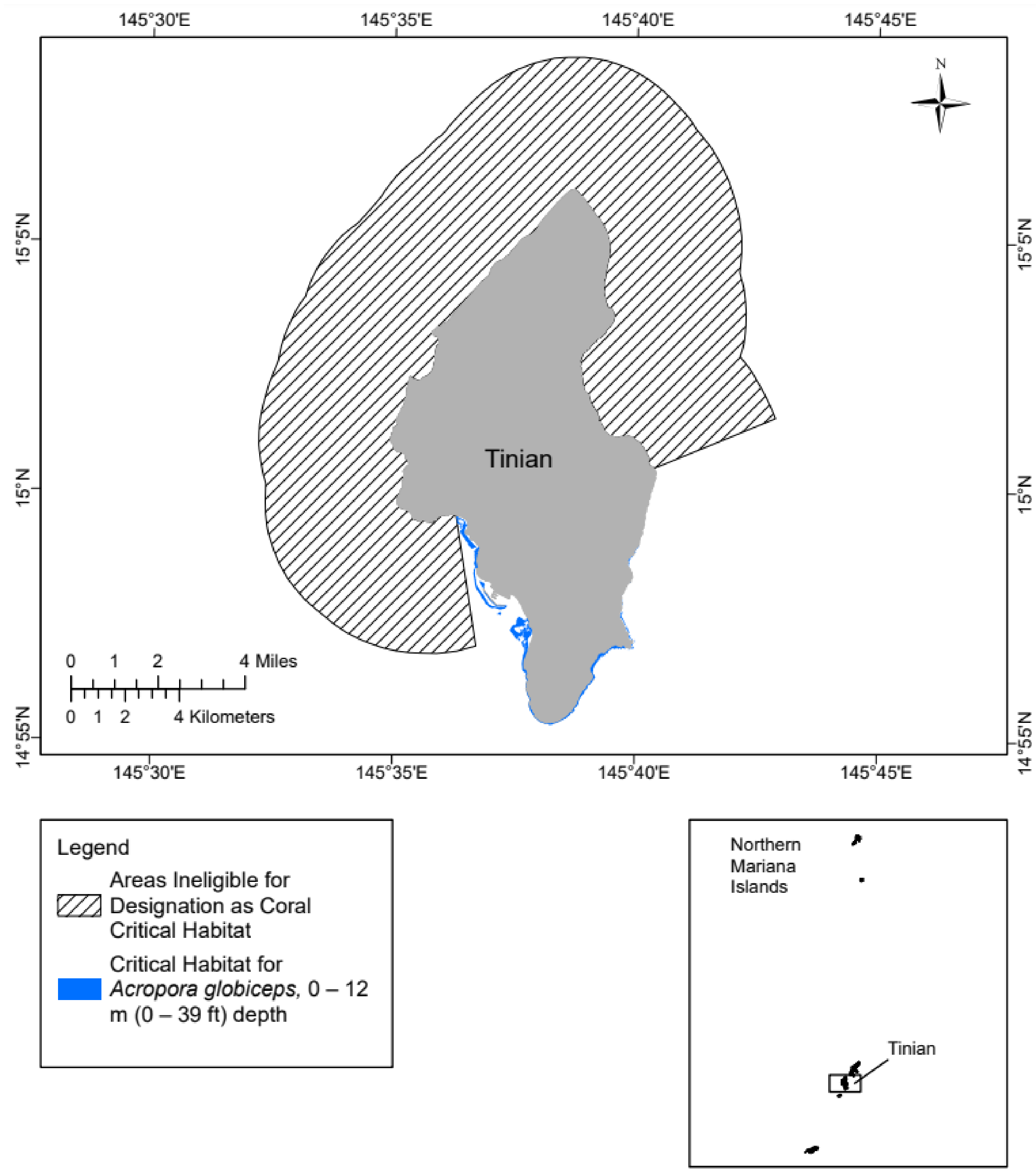

Figure 17. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 12 m depth, blue) in the Tinian Unit, and the 4(a)(3) ineligible area.

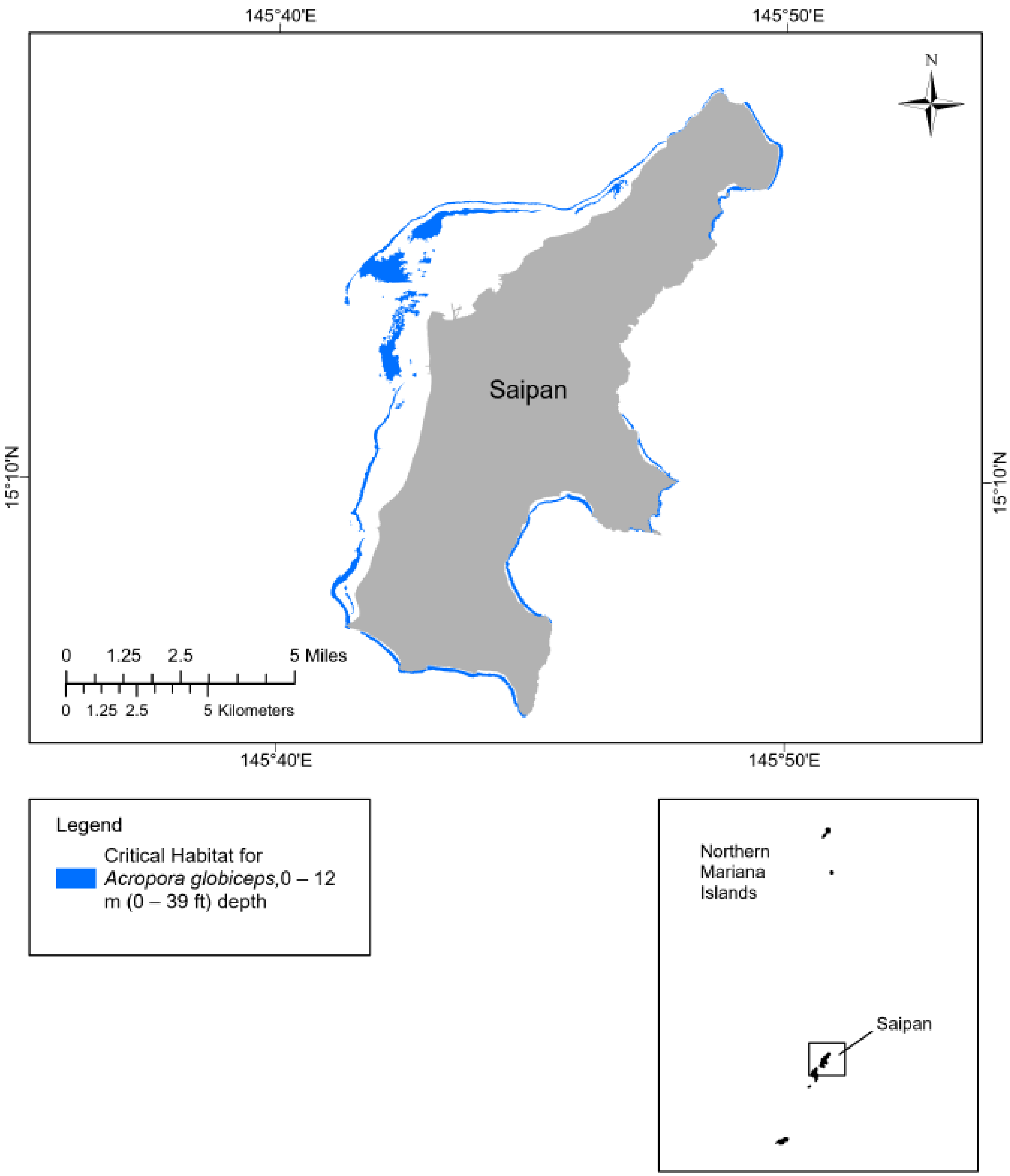

Figure 18. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 12 m depth, blue) in the Saipan Unit.

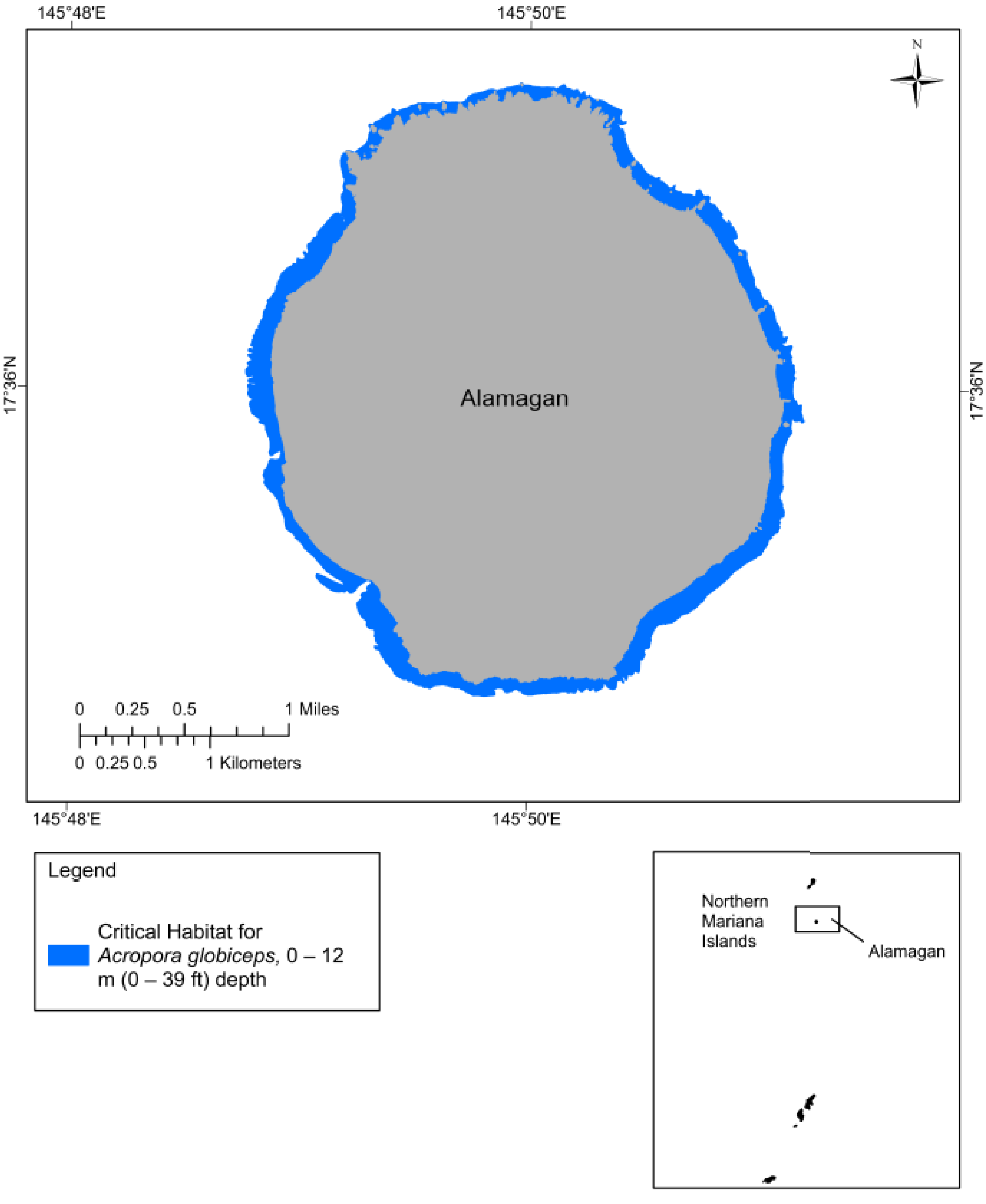

Figure 19. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 12 m depth, blue) in the Alamagan Unit.

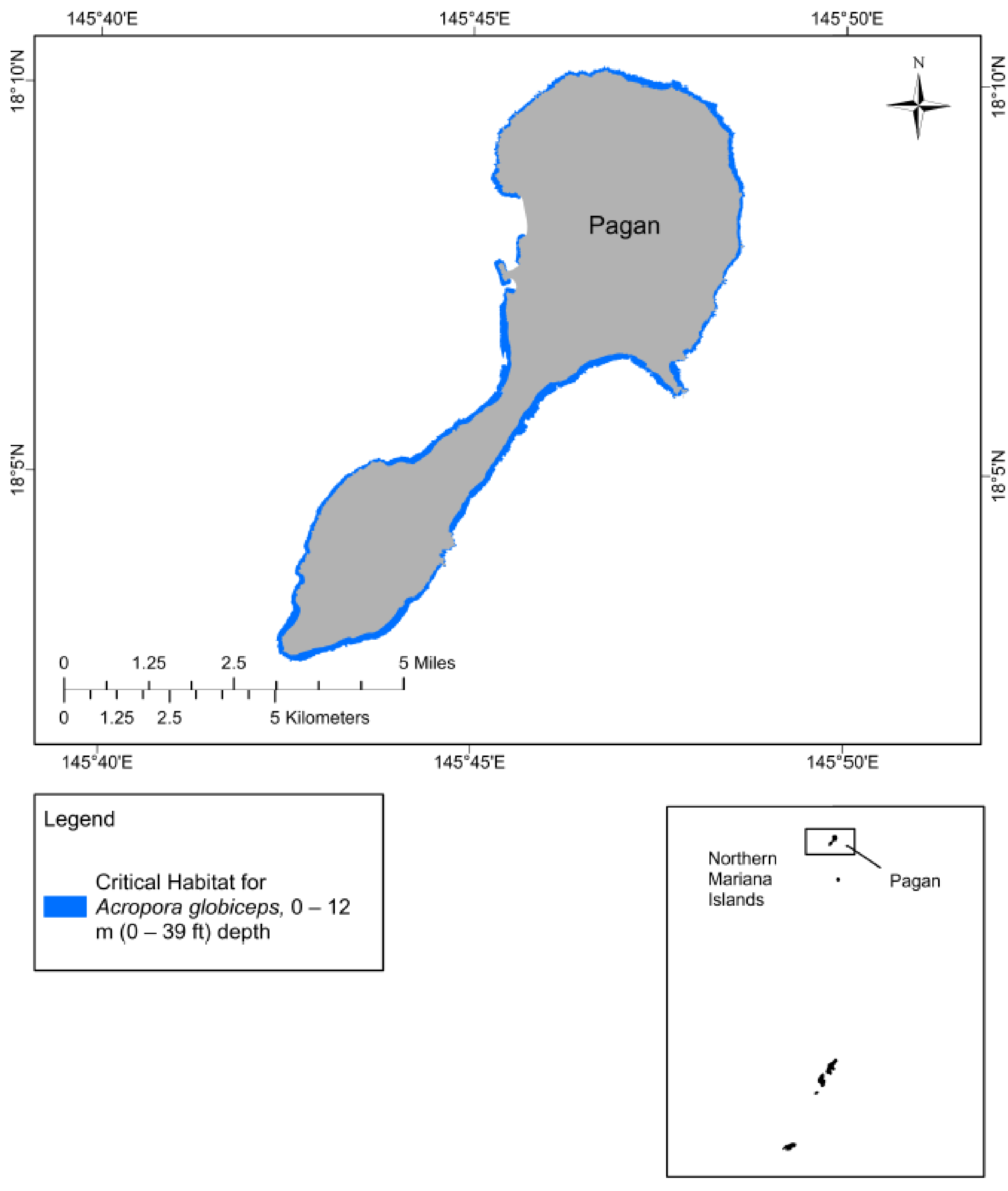

Figure 20. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 12 m depth, blue) in the Pagan Unit.

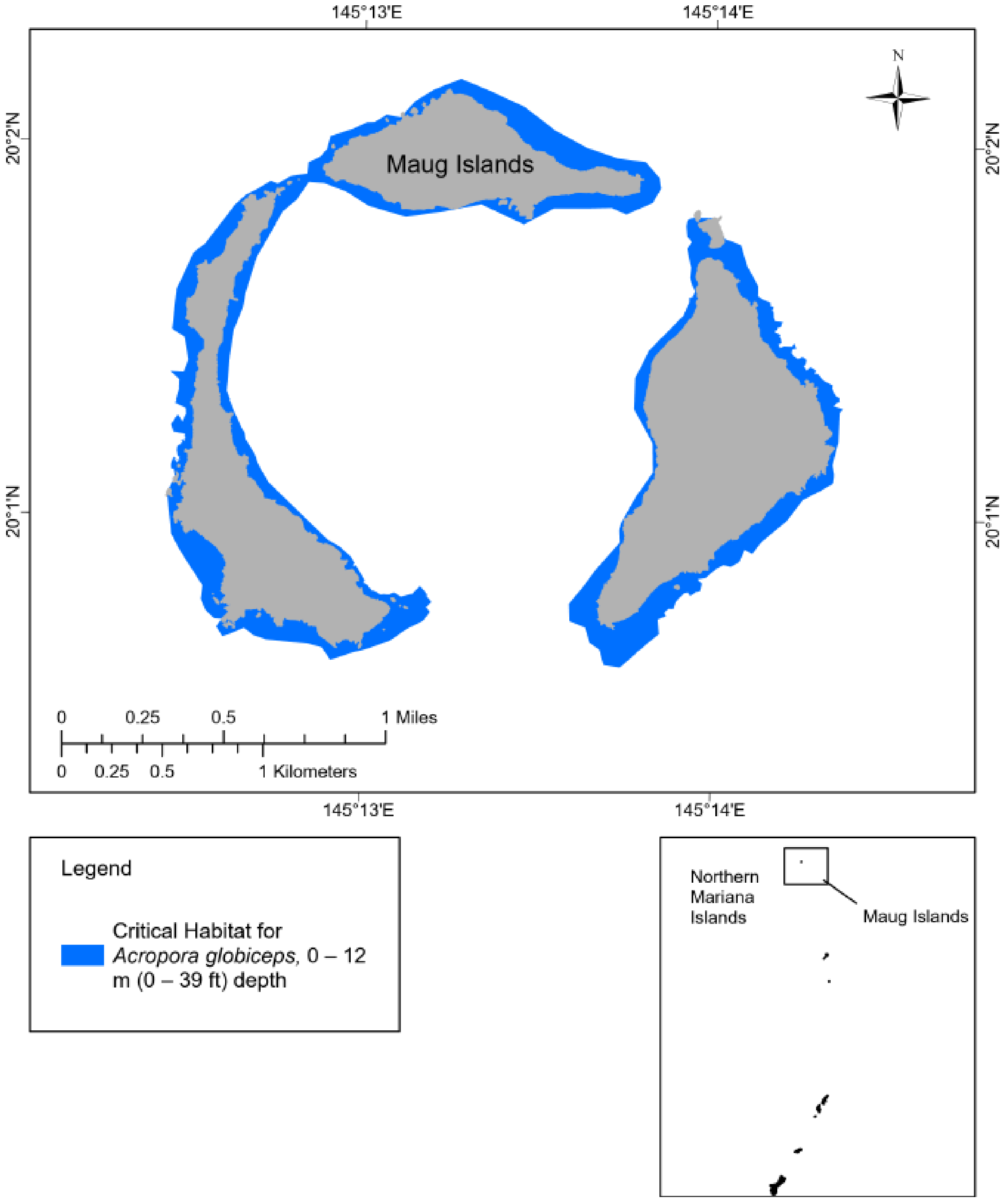

Figure 21. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 12 m depth, blue) in the Maug Islands Unit.

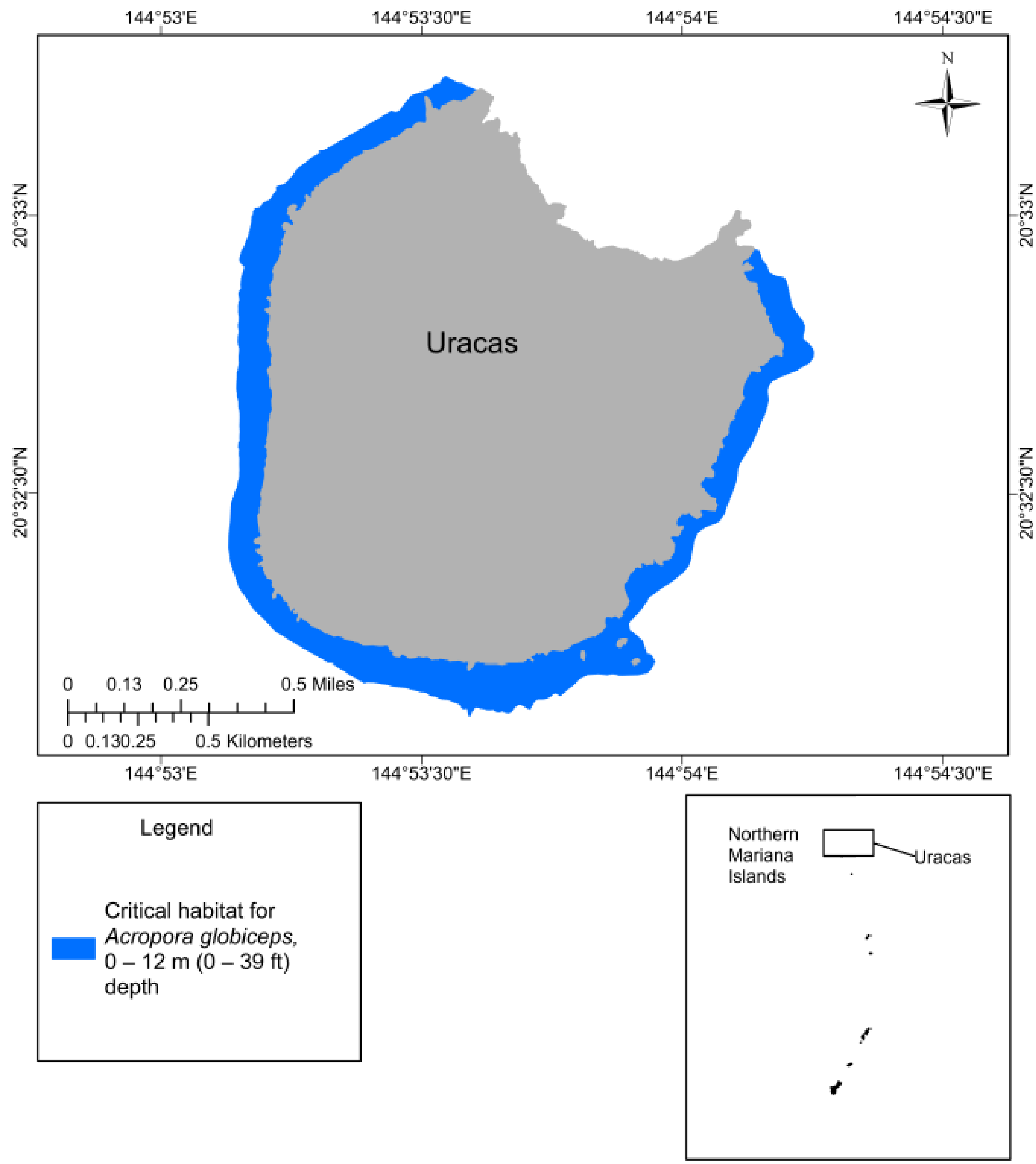

Figure 22. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 12 m depth, blue) in the Uracas Unit.

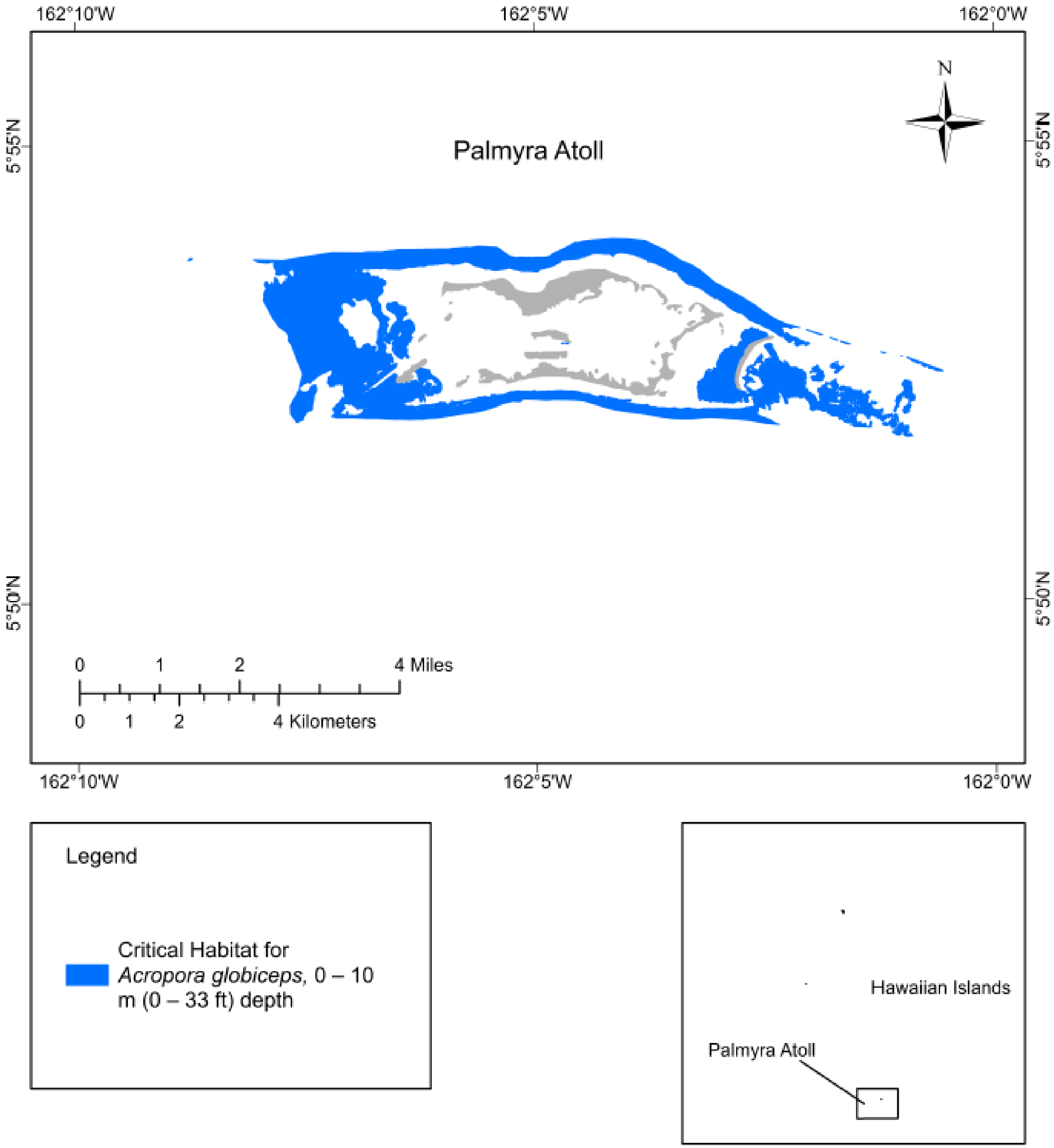

Figure 23. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 10 m depth, blue) in the Palmyra Atoll Unit.

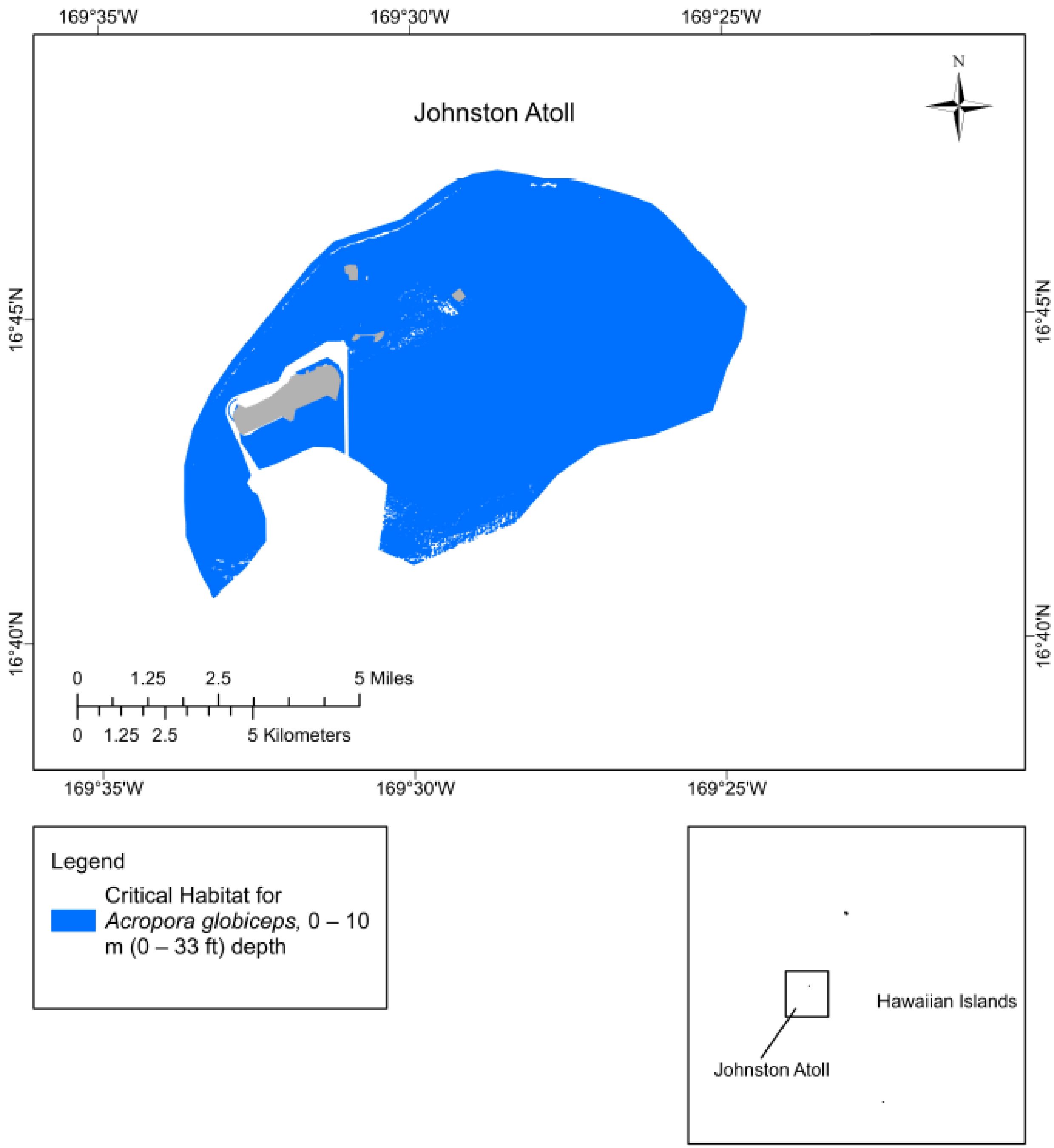

Figure 24. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 10 m depth, blue) in the Johnston Atoll Unit.

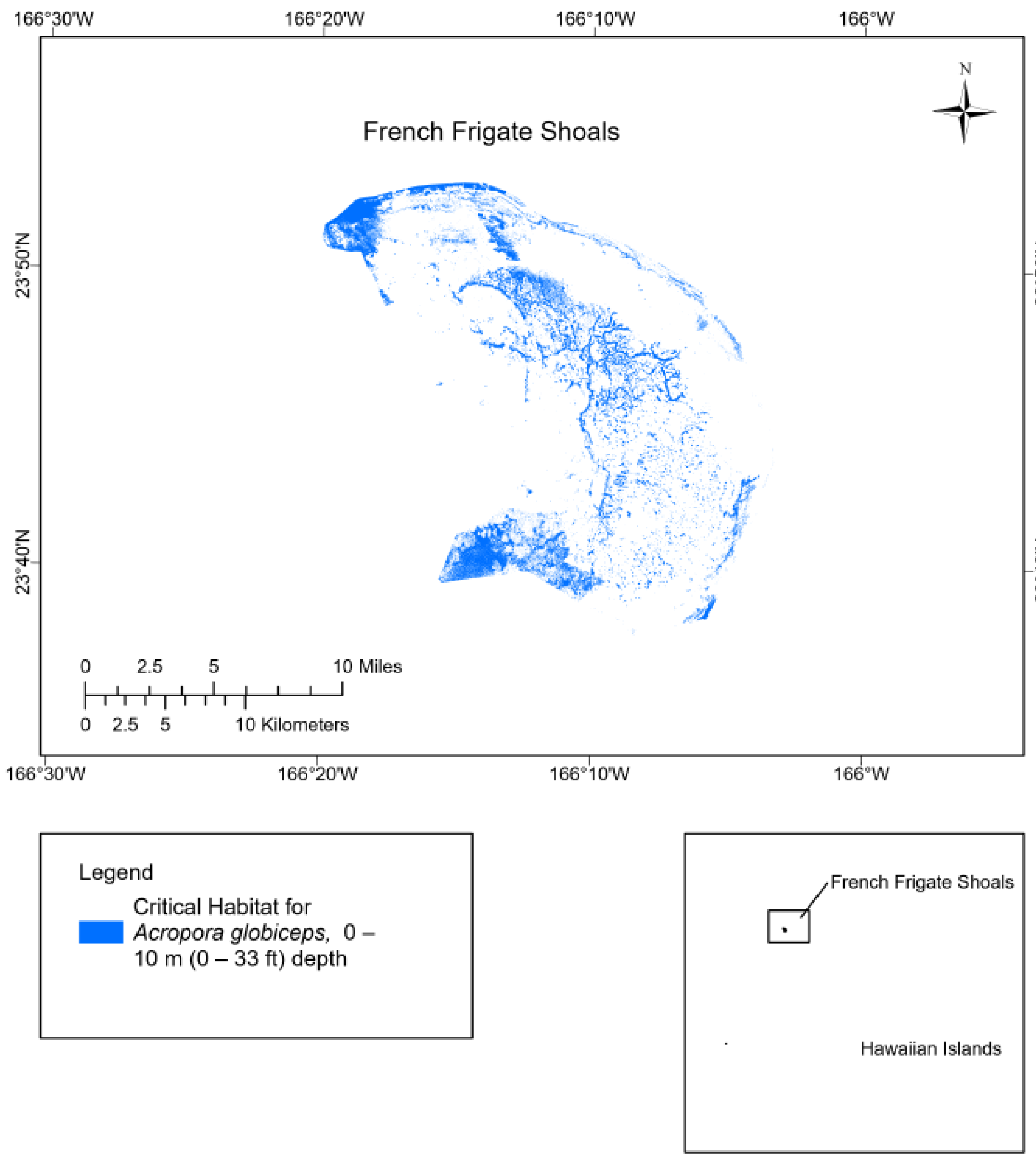

Figure 25. Specific areas of proposed coral critical habitat for *A. globiceps* (0 – 10 m depth, blue) in the French Frigate Shoals Unit.

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